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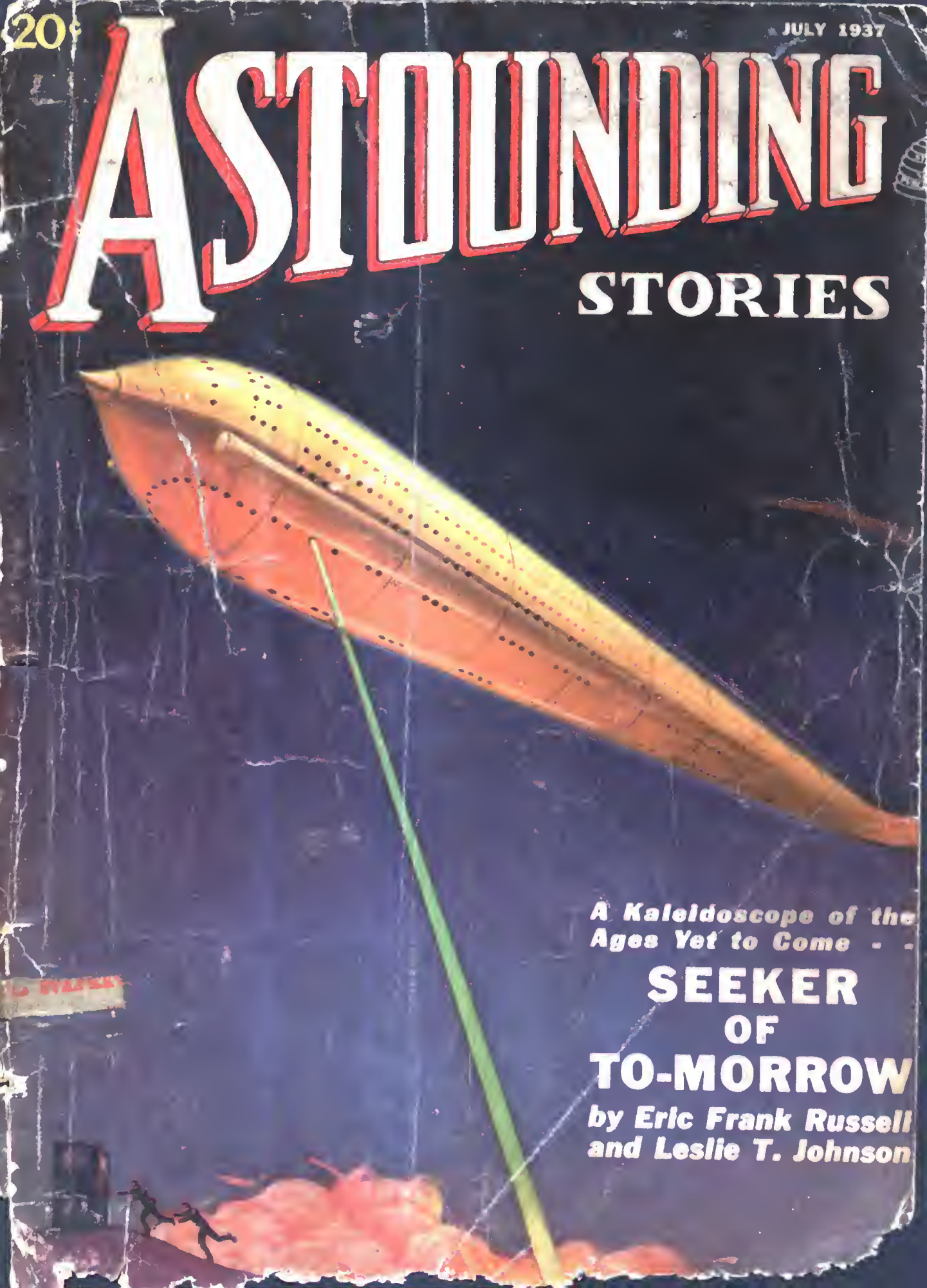
ASTOUNDING STORIES



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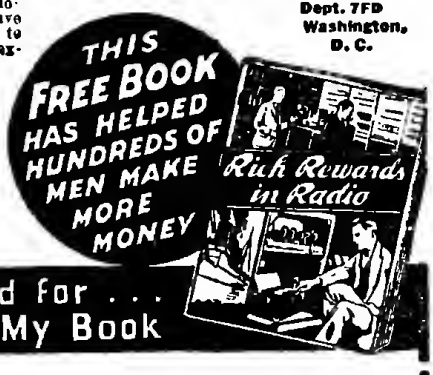

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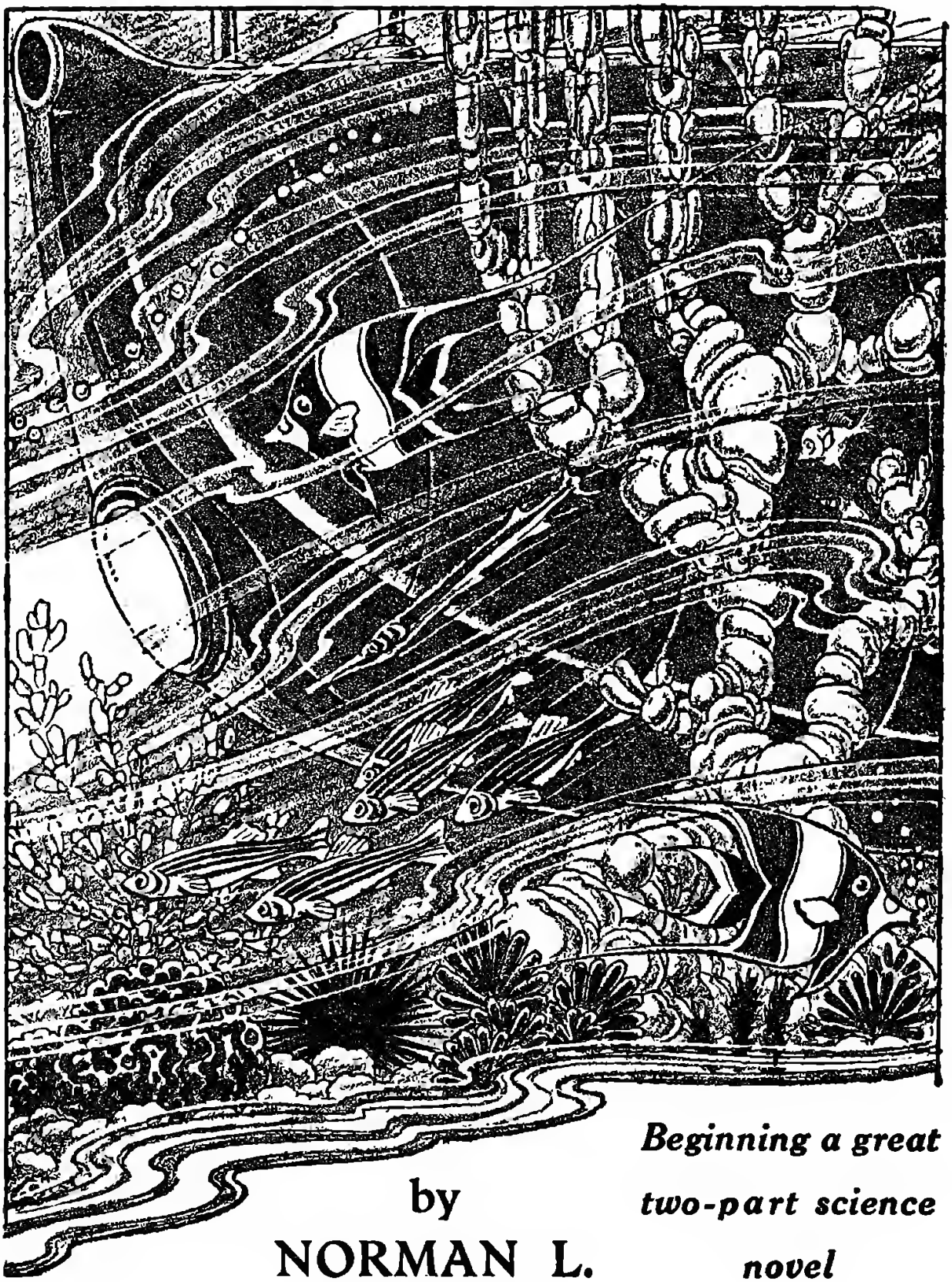
Part One

Wainwright lifted the electric lance—let fly with five hundred volts—— The thing tied itself into a thousand knots—and died——

SILENCE as ancient as the sea brooded over the ravine. A quivering green twilight veiled its multicolored walls of pitted rock, a twilight pierced by a million uneasy, shifting, flickering ghosts of slanting, green-tinged sun rays. In the midst of the ravine the trembling illumination played over a great dome of deep-violet stone, overgrown with clustering myriads of what appeared to be small flowers.

An observer projected unexpectedly into these surroundings for the first time —assuming him to be so equipped and protected that he could observe, and analyze his impressions—might have doubted that he still remained upon his native earth. On all sides he would have seen unearthly hues and anomalous forms.

the UNKNOWN



Beginning a great two-part science novel

by NORMAN L. KNIGHT

Beyond the dome of violet stone rose other domes in other shades of violet and lavender, bespangled with other strangely writhing flowers that glowed with a soft iridescence of garnet and turquoise in the beryl-green sunlight flowing ceaselessly over them in waves and ripples. Among the domes and beyond them, rising in tiers as the ravine sloped upward, were great, fanlike forms of cerise and saffron, towering cups and chalices in maroon and glowing brown, massive branching shapes of malachite-green and rose-pink.

The fan growths bent and swayed slightly, as though before a gentle breeze that drifted up the slope toward an unseen summit lost in a luminous emerald obscurity. Above, instead of sky, a firmament of bluish jade-green ebbed and flowed in waves of color. Below, the ravine widened and sloped downward into mysterious profundities of peacock-green, cobalt-blue, purple, and finally black.

The hypothetical observer would have received his first clue as to his true location from the school of obviously terrestrial fish that now swept down the ravine, their bodies gleaming like silver and bronze foil. Some small object plunged downward from the surface, followed by a sparkling trail of bubbles, and the entire school converged upon it like a flight of flashing javelins.

THE NEXT INSTANT their vagrant interest was diverted by the grotesque being that had materialized out of the aqueous green mystery at the head of the ravine, and they shot away to wheel about it in glinting, intersecting orbits. It was approximately human in form and strode onward with ponderous deliberation.

The soft-green sunlight winked and sparkled from the points and ridges of its blue-black helmet head and silvery metallic integument. A wavering fan of bubbles issued from the head and soared upward like buoyant, quivering globules of quicksilver. A pair of bulging knobs protruded from the helmet's top, like frog's eyes, and a triad of circular openings constituted the "face." A rounded case between the shoulders made it appear humpbacked. There were spherical swellings at its knee and elbow joints, and bristling spikes upon its knuckles.

Our observer might not have known that the two black knobs were the external parts of aerophores, or artificial gills, but by drawing near and peering into one of the three openings in the helmet he would have discovered that the latter were little windows—or more correctly, eye ports—with a human face behind them.

The man inside the armor was apparently carrying on a monologue, but in reality it was a radiophone conversation.

"Bring the ship over here on the other side of the reef," the man in armor was saying. "I've found the bait. Last night's storm shifted the marker buoy. And keep my power beam focused *somewhere* in my vicinity; my gill motor is running only half of the time."

"I'm keeping the beam trained on you as well as I can, Ogelthorpe," responded a voice at his ear. "There's a stiff current here and the ship is wabbling a bit. We'll be over as soon as Belknap untangles the buoy cable. It's bent around a big chunk of stag-horn coral."

"Lift away, skipper; I'm aboard," came a second voice in Ogelthorpe's ear phones, "and the buoy is lashed fast to a handrail. Now let's tow it back to where it belongs."

A remote humming became audible to Ogelthorpe as he continued to stride down the ravine at the slow-motion, plodding gait that is imposed upon human beings by submarine conditions. He blundered against the violet dome and the crimson polyps contracted to

their absolute minimum of size in a spasm of alarm. At last he emerged from the ravine among the waist-high growths of a veritable submarine meadow; swarms of little green-and-gold fish rose from about his feet like coveys of quail from tall grass. After a few cautious steps he paused, fearing pitfalls concealed by the undulating algæ, and waited.

THE HUMMING steadily increased in volume and finally Ogelthorpe beheld a greatly elongated blue-gray shape, very like an enormously magnified shark, taking form out of amethystine distances. Here and there upon it portholes gleamed like staring green eyes.

As it swam cautiously forward and downward and drew nearer, it ceased to be a blue-gray silhouette and became a silver-gray streamlined hull. The blunt-nosed prow bore the name *Narwhal* in letters of gleaming, white metal, and immediately astern of that the lateral rudders projected like a pair of fins. The words "Submarine Products Corporation" shimmered in similar letters along the sides of the triple-turreted conning tower—whose ports were now dark, since it was used only in surface cruising.

The ports of the undersea navigation cabin in the forekeel gleamed greenly. A rhythmic outpouring of argent clouds of air bubbles at the stern was the only indication of the propulsive water jets. The craft inhaled sea water through its huge aerophores, extracted air therefrom, and exhaled vitiated air along with the turbine-driven water from the vents at the stern.

"Show a light down there," came the voice of the navigator. "Let's see where you are."

Immediately, an orange-red light blinked three times on the forehead of Ogelthorpe's helmet.

"Did you see that?" queried Ogelthorpe.

"Like an airport on a clear night," was the reply. "Belknap and Osborn are coming down."

The craft now came to rest above him at an altitude of ten fathoms and the hum of its turbines slid down an octave in pitch. A great cloud of fish, including half a dozen sharks, revolved about it. A circular aperture emitting a faint, bluish light opened in its mid-keel, and another armored figure was lowered therefrom at the end of a light cable attached to a ring at the nape of its neck. As soon as this individual touched bottom, the magnetic clasp of the cable was released with a loud click; the cable was swiftly drawn up again, and a third man descended.

"Well, Ogelthorpe, how did this bait work out?" asked Belknap, the first one to come down. "Osborn, our worthy biochemist, rather expected it to make all the barracudas in the eastern Atlantic Ocean come a-running and die happy."

"The aquarium tests showed it to be at least ten times more potent than any previous bait," declared Osborn defensively.

"No argument about its potency," agreed Ogelthorpe. "It attracts them, but it doesn't last. Under natural conditions on the ocean bottom it seems to deteriorate. Its odor is destroyed, or it dissolves away too rapidly, or some other blighted thing happens to it. It isn't working now, and it has been set out less than four days. Come, I'll show you."

FOLLOWING OGELTHORPE, they plodded with elephantine slowness a short distance up the ravine. Ogelthorpe paused at the entrance to a little glade in a bower of massive coral growths like stunted trees of corrugated verdigris. Driven into the white coral sand of the glade were perhaps fifty metal rods, each supporting at its upper end the gayly-colored simulacrum of a little fish undulating in the slight cur-

rent in a lifelike manner. Strewn among these rods were the bodies of a number of formidable creatures—elongated, almost serpentine, fish three to six feet in length, their cruel, reptilian jaws bristling with teeth. Each body was bent into an arc, as if it had stiffened and died in a convulsive agony.

"There you are," said Ogelthorpe. "The little fish are merely wire frames stuffed with kelp cellulose impregnated with Osborne's bait—dimethyl-benzyl-isocarminol I think he calls it—and a perforated bulb filled with crotalidine inside of that. The barracudas smell the bait and bite the fish, causing a little poison to be ejected, and that ends the barracuda. One charge of poison should last at least a week, but all these barracudas were killed the first day and there have been no more casualties since then. I came every day and looked. That means that the bait is no longer active."

"Perhaps the crotalidine is too soluble," suggested Osborn hopefully.

"No. We've checked up on that," declared Ogelthorpe; and then addressing the navigator of the sleek, silver-gray shape which still hung overhead, humming as it breasted the current, "Well, skipper, how about heaving over the end of the buoy cable?"

"Where do you want it? Where are you? Show a light again," came the somewhat peevish response. "I can't see you down there in the shadow."

"Bring the ship down a bit and turn on the floodlight," suggested Ogelthorpe.

"Can't. The water's full of eddies and cross-currents from here on down. Do you want the *Narwhal* stove in on this blighted reef? It isn't called Diabolo Reef for nothing."

"All right, I'll show a light in a minute," answered Ogelthorpe, turning and commencing to pick his way downhill among the coral boulders. "But first I must find the place. While I was waiting I saw a sort of natural bridge of coral several fathoms farther down. A few turns of the cable around that and a hurricane can't drag our buoy loose."

Belknap and Osborn, following more slowly down the ravine and along the margin of the algal meadow, saw his green-glittering shape become a mere wavering shimmer as of tarnished copper in the deeper and duskier waters.

"If we can't devise a satisfactory bait in the near future, we'll have to surrender the barracuda problem to the Genetics Section," grumbled Osborn. "In the meantime these shoals of barracudas are pirating the choicest part of this year's crop in the Caribbean. Headquarters estimates that thirty per cent of the tuna are gone and at least as much of the pompano, and the stockholders are filling the air with static. It's the worst outbreak of predators since the dogfish episode of fifteen years ago."

"That would be 1996," ruminated Belknap. "I had almost forgotten it. Your poison-bait scheme succeeded in controlling that, I remember."

"Yes. But the Genetics Sections clinched the matter with an artificial, specific, and fatal parasite."

"Why didn't the Genetics Section get this problem in the first place?" demanded Belknap. "Can't they produce a fish with a natural animosity toward barracudas only?"

"They are developing a hard-shelled, fast-swimming octopus with that propensity," admitted Osborn, "but it will take years. Creating a new species is always slow and usually uncertain. But so far we have had very good results with baits and poisons. A synthetic specifically attractive water-soluble odor and a quick-acting poison broadcast over the feeding area——"

"The skipper was right!" exclaimed the now-invisible Ogelthorpe with a note of alarm. "There *are* some terrific eddies down here! A little more and I'll have to crawl on hands and knees."

"Wait, Ogelthorpe. Let's keep together," admonished Belknap.

"I'm all right," Ogelthorpe assured him.

"Your system is good as far as it goes," continued Belknap to Osborn, "but I'm only a submarine structural engineer and perhaps don't appreciate biochemistry as I should. Consequently, I still maintain that in the end we must completely inclose all our farms with walls of vitrolith and roofs of structural glass, filter all the water, regulate the temperature——"

"Submarine hothouses for fishes and sponges, not to mention crabs and oysters!" jeered Osborn. "We might also regulate the temperature of the Caribbean Sea. You have an imagination anyhow."

"Keep your eye on your course, you fellows!" called Ogelthorpe warningly. "These currents would twist the stern off a polar ice breaker. We're near the edge of the reef, and it goes down deeper than——"

HIS WORDS ended in an explosive gasp and a muffled exclamation. Then a heavy clank, a sizzling snap, and silence.

"What happened? What was that? Are you all right?" simultaneously queried the captain, Osborn, and Belknap.

"Something's wrong! Ogelthorpe's power beam just now blew a fuse!" cried Captain Kielson.

"Can you get anything on the phone? He has an emergency battery, hasn't he?" demanded Belknap.

"I have the phone focused right on him but nothing responds except a little induction hum from his armor. All his apparatus seems as dead as a wet motor. Here, I'll give you what light I can!"

A great circular eye of intense blue-white light blazed into being on the forward keel of the craft, throwing the weird coral formations into a confusion of glistening green high lights and violet shadows. Osborn and Belknap saw that the downward slope before them ended suddenly in a fringe of sea fans not many yards ahead. One of the fans had evidently just been shattered, as several of its fragments still clung to neighboring growths, oscillating in a powerful, fluctuating current.

On reaching this point the two men gazed, appalled, down a sheer cliff from which occasional clumps of stag-horn coral projected, into an abyss that shaded into emerald, then indigo, purple, and at last black. Just at the limit of visibility, wedged in a mass of coral, something glimmered like a mirror.

"Lord! It's Ogelthorpe! He must be fifteen fathoms below!" cried Belknap. "Stand fast, or we'll go, too!"

The two men gripped each other as a vicious swirl of water spun about them and sent them staggering together with a dull clang of armor against armor.

"Give me a lift with a cable; I'm going down after Ogelthorpe!" rapped Osborn to the commander of the *Narwhal*. And then to Belknap, "You had better lie flat or you'll be washed over. And keep your eye on me in case anything happens to me or my phone."

While Belknap slowly lowered himself to a prostrate position, with his head projecting over the cliff's edge, a cable dropped down from the *Narwhal* and Osborn snapped its clasp fast to the ring at the rear of his helmet.

"Now lift away, swing me out, and then let me down and veer back slowly. Try not to knock me against this confounded cliff," he called.

THE RIM of the cliff, with Belknap reclining among the sea fans, seemed to fall away from him and then to recede into a greenish semiobscurity. He found himself dangling over the purple-black gulf. Then the face of the cliff appeared to slide slowly upward and to draw near again, as the *Narwhal* veered back

toward it, the hum of the turbines rising slightly. The faint glimmer of Ogelthorpe's armor grew more distinct, until Osborn could plainly see his metallic shape. A questing shark circled him leisurely.

Suddenly, the cliff seemed to rush at Osborn and dealt him a stunning, resounding blow.

"All right, Osborn?" called Captain Kielson anxiously.

"Guess so," gasped Osborn. "Eddy threw me against the cliff. Lower away about two more fathoms and let me have another cable."

Another rushing vortex almost threw him against Ogelthorpe. He fended himself off from the prongs of coral with his steel-gauntleted hands and awkwardly found a footing astride the motionless figure. As the nosing shark drew near again he thumped it with his knuckle spikes and it nonchalantly withdrew a short distance. Then the second cable dropped down beside him, the terminal clasp rapping on his back plates. Seizing the clasp, he bent over and brought his helmet close to Ogelthorpe's, scrutinizing the latter's face through the heavy lenses of silicoid, by the light of the phospho-ray lamp built into the left wrist of his own armor.

"What do you see?" came Belknap's voice.

"His eyes are closed," replied Osborn, as he attached the second cable to Ogelthorpe's neck ring. "His gill motor must have stopped; I can't hear it hum. His armor seems tight enough; no bubbles escaping anywhere and no water to be seen inside his helmet. But there seems to be a sort of luminous film fogging the inside of his eye ports, and something green trickling over his forehead. I think——"

Osborn brought his lamp nearer. "Lift away, skipper, lift away!" cried Osborn. "His uranium battery has cracked and the fluid is leaking into his helmet! If it gets to his eyes——"

Osborn and Ogelthorpe rose swaying together through the whirling eddies, the inquisitive shark following in ascending loops and spirals.

II.

OGELTHORPE'S muscular frame, completely depilated as was the widespread practice of the times, lay immobile as a mummy upon a slab of opalescent glass under the steady, green-white glare of a battery of great lamps. His arms lay beside him, rigid as though frozen, the hands half clenched. His lips were bloodless, his nostrils contracted.

A strip of glistening, transparent green membrane was affixed around his shaven head and covered his eyes, which were closed and sunken in their sockets. Just above this band a silver ring encircled his temples and tiny flashes of blue light raced round it in ripples. Outside the blaze of the lamps loomed a dark mass of apparatus, suggesting a miniature pipe organ in outline, which emitted a sustained soft droning.

The activities of the green-smocked and skull-capped surgeon who bent intently over Ogelthorpe heightened his resemblance to a mummy—in the process of being divested of its wrappings. With slender hands gloved in transparent rubber, she methodically stripped off an adhesive coating of elastic, scarlet substance which covered most of his torso, head, neck, and upper arms. Her finely-molded and obviously Mongoloid features, half covered by a respirator of flexible glass, expressed an entire obsorption in her task, and occasionally she made a slight hissing through her teeth. The strips of scarlet tissue were dropped into a white-enameled tray upon a metal stand beside her, where they slowly curled and twisted for several moments, as though possessed of transitory life.

A mulatto assistant, clad, gloved, and

masked in the same fashion as the sloe-eyed surgeon whom he faced across Ogelthorpe's body, deftly massaged the newly uncovered epidermis with his finger tips, a small buzzing vibrator strapped to the back of each hand. A second assistant—a dark-skinned Latin type—alternately hovered at Ogelthorpe's head, scrutinizing the blue-flickering silver ring, and retired to mysterious consultations with the droning apparatus in the background.

As the scarlet tissue was progressively removed, a strange appearance of the underlying skin was revealed: In general, it had the deep, golden-bronze tint of a white skin that has been much exposed to sun and wind, but imprinted upon it, and giving it an oddly maplike appearance, were irregular branching and interconnected areas of delicate rose-pink, like the skin of a baby. They were especially large and numerous over the chest and shoulders and might have been bleached by the trickling, spreading flow of some extraordinary fluid.

AS A MATTER OF FACT, they were the areas of new skin that had been caused to overgrow the regions burned away four days previously by the corrosive radioactive fluid from Ogelthorpe's battery.

"As always, your technique is rapid and perfect, Dr. Feng," the mulatto assistant murmured deferentially in Esperanto. "A few days under the sun lamps and this new growth will be indistinguishable from the rest."

"The patient has an exceptional physique," returned the surgeon with a shrug. "Such a case as this would ordinarily require five days of healing in the accelerator, and a complete absence of scars is unusual. Nevertheless, and although it is no affair of mine, I am annoyed—even angered—by the occurrence of such an accident as this. It was avoidable, Julian, avoidable without doubt. Uranium batteries in diving armor are known to be hazardous; also, they are obsolete. We have had two other cases of the same type this year. I cannot comprehend why a great corporation such as Submarine Products should continue to expose its men to these dangers."

"It is the old story," said Julian, massaging busily. "Such things must happen two—three—four times, maybe more often, before something is done. However, as I listen in the news room this morning, I hear that Submarine Products is rebuilding two hundred diving units. This man—what is his name? —has wrought a reform by falling over a precipice."

"His name is Ogelthorpe," replied Dr. Feng, knitting her delicate black brows slightly as she loosened a stubborn section of the scarlet tissue with an aromatic mist from a compressed-air atomizer. "Fortunately, he did not suffer the agonies of the previous victims. He was yet unconscious when removed from his armor, and the ship's doctor immediately injected apathine. Since coming here, of course, he has been in the Sleep."

For a time there was silence save for Julian's buzzing vibrators and the somnolent droning of the mechanism supervised by the second attendant.

"Now it is finished," declared Dr. Feng at last.

"Except for the eyes," remarked Julian, glancing at the transparent green band through which Ogelthorpe's closed eyes were visible.

"With which I do nothing," returned Dr. Feng. "The eyes are Dr. Carmoda's work, who has said they will be unable to see until this afternoon. But let us release our patient from the Sleep; he need remain no longer endormant."

Then, speaking over her shoulder to the second attendant and relinquishing Esperanto for Spanish, "Enough, my Trentino. Remove the ring."

THE DRONING rose slightly in pitch, then fell gradually and faded into silence. The shivering blue flashes that pursued each other around Ogelthorpe's silver head ring grew small and dim, flickered out, reappeared spasmodically, and vanished.

The one addressed as Trentino now advanced, bearing a magnalium box lined with black velvet, gently removed the ring, placed it in the box, snapped shut the lid, and retired carrying his burden as though it were the great Enderby Diamond.

A tremor passed over Ogelthorpe's body and his chest rose and fell with a sigh. Julian quickly inserted the needle of a hypodermic in Ogelthorpe's left arm, withdrew it, and applied the microphone of a stethoscope to his chest.

"All goes well," announced Julian, listening. "The Sleep passes."

Ogelthorpe sighed again and then spoke. His voice came thin and faint, as if heard through a long speaking tube. "Wainwright, I can't see!" he complained. "Where are we? How long have I been unconscious?"

"In the arm again, Julian," whispered Dr. Feng, and the injection was repeated. Then aloud, in English. "You have been unconscious about four days, Mr. Ogelthorpe, but do not alarm yourself. You are——"

Ogelthorpe interrupted in a greatly strengthened voice, tinged with amazement and anger. "Who in the name of Moby Dick are you?" he demanded. "And my name isn't Ogelthorpe. It's Wilkes—Stephen Wilkes. And where's Wainwright? Where's Hill? What's wrong with my eyes? Why can't I move?"

Dr. Feng arched her eyebrows and exchanged astonished glances with Julian. "I am Dr. Feng of the Cuban Medical Center at Havana," she replied pleasantly. "Submarine Products brought you here. We were told your name is Ogelthorpe. There has been no one here by the name of Wainwright or Hill. Your eyes were injured by fluid from your uranium battery after you fell, but will be all right in a short time. You will be able to move as soon as the effects of the Sleep have passed away."

"May I be cut up for shark bait!" cried Ogelthorpe. "You're crazy. My name is Wilkes. I didn't have any fall. A chunk of pumice stone fell on my head. And how in Gehenna can I be in Havana? How did we get out of the crater? Who are you? What have you done with Wainwright and Hill? I don't believe a damned word you say!"

"He is delirious," murmured Julian in Esperanto.

"Perhaps," replied Dr. Feng, frowning dubiously.

"I'M CHILLY!" Ogelthorpe snapped. "You have me somewhere inside the power plant, haven't you?"

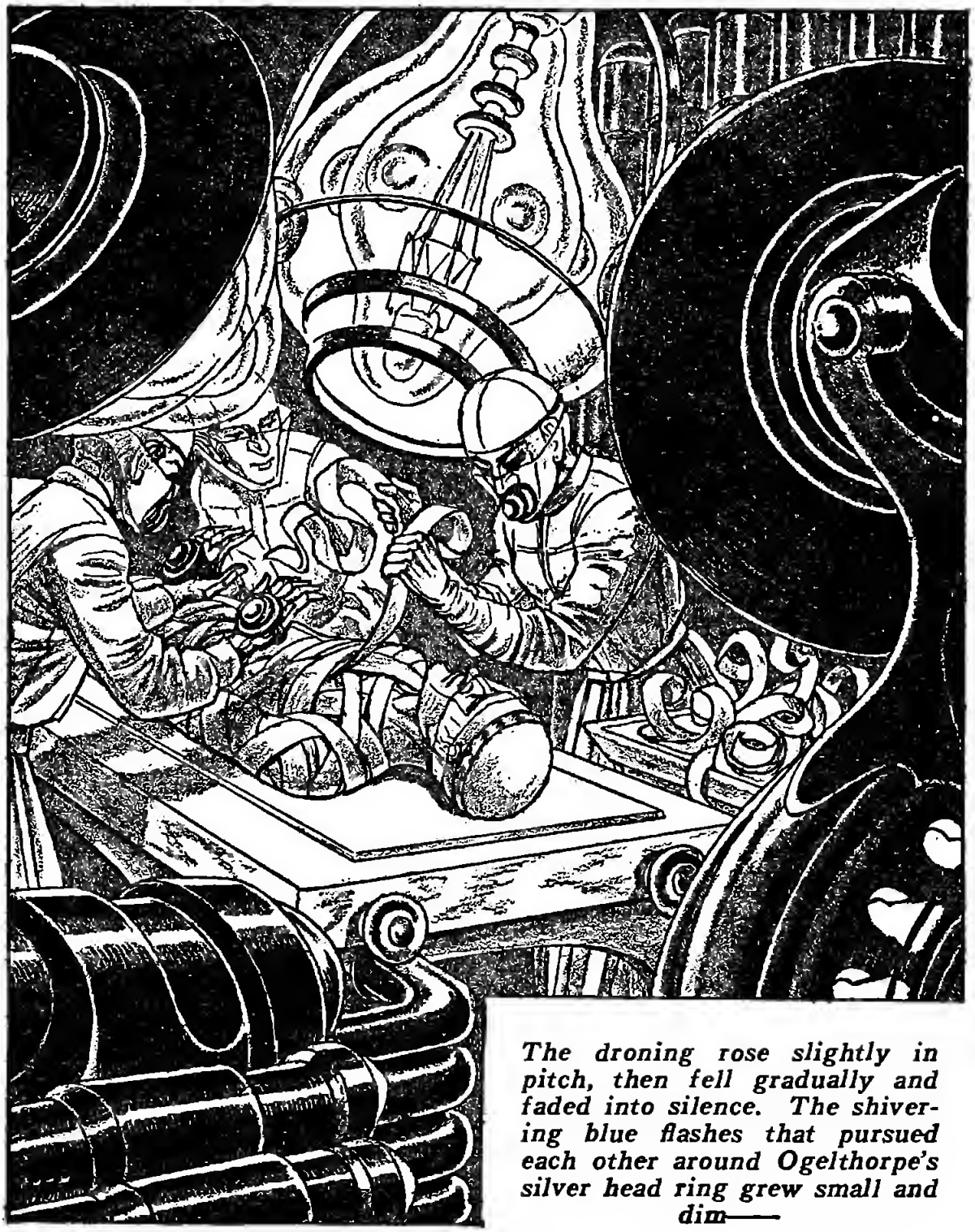
"It is the chill that one feels after the Sleep. You shall have a little warm kaffina at once," Dr. Feng assured him, nodding to Trentino. "In a moment, after we have taken you to your room, you shall have food, also."

"Why keep on trying to rig me into believing that I'm in a hospital? Do you take me for a moron?" raged the incomprehensible Ogelthorpe. "I know where I am. For some purpose of your own you have taken me into the power plant and paralyzed me with drugs. Probably Wainwright and Hill, also. That's why it's so cool; if I were outdoors in the crater it would be hot and humid. I suspected from the first that there was a white man or woman back of this power-plant mystery. Come on, tell me your racket and get it out of your system."

"Pray do not so alarm yourself. Here is your kaffina," soothed Julian, taking the magnalium cup from the attendant, who had answered Trentino's summons,

and raising it to Ogelthorpe's lips with one hand while supporting his head with the other. Ogelthorpe gulped the liquid gratefully. When he next spoke it was in a much calmer tone.

"Of course, I may have been dead to the world for several days and Wainwright and Hill might have escaped and rushed me to Havana in the meantime," he mused. "You say that Submarine Products put me here. But why Havana? Panama would have been closer. And I hear two people talking English and Esperanto with a Spanish accent. That could be in either Panama or Havana. But how could I be mixed up



The droning rose slightly in pitch, then fell gradually and faded into silence. The shivering blue flashes that pursued each other around Ogelthorpe's silver head ring grew small and dim——

with some one named Ogelthorpe? My name is Wilkes. Do I *look* like this Ogelthorpe person? There's a poor connection in the circuit somewhere."

"Julian, there is something strange here—not delirium, but some other vagary of the mind," declared Dr. Feng, drawing her assistant aside. "See that this man is taken to his room and call some one from the Psychiatric Section. If possible, get Dr. Lemoyne, the telementator, and let me know when the examination will take place, as I wish to be present unless my work prevents."

III.

THE ORDERLY on duty at the desk in the reception room thumbed rapidly through a rack of alphabetically indexed cards and glanced curiously at the two individuals who stood uneasily waiting. Both wore the dress uniforms issued by the Submarine Products Corporation to its employees for street wear in tropical climates: loose, sleeveless shirts of cream-colored, artificial silk with roll collars; sea-green knickers of the same material, secured by a belt of gray-blue sharkskin leather with a chromium buckle; olive-green half hose woven from kelp cellulose; and sandals of the same material as the belt. An emblem of gold inlay on the belt buckle indicated the individual's official status.

One of the two was Lloyd Osborn, Ogelthorpe's erstwhile rescuer and his assistant chief in charge of Pest Eradication—slender, sun-burned, his black hair close-clipped, and with an habitual preoccupied expression that even anxiety could not entirely efface. The other was Sonia Hogarth, Ogelthorpe's half sister, ivory carver in the Ornament and Novelty Section, gracefully muscular, also sun-burned, and with her head totally depilated—thereby revealing its beautifully spherical and uniformly tanned contours.

"Yes, you have an appointment to see Señor Ogelthorpe at ten o'clock," the orderly finally announced in Esperanto. "It is that time now, but unfortunately all the guides are out at this moment. One of them will return very soon and show you to his room."

Then, in a mildly curious manner he inquired, "You are from the Submarine Products Co., is it not so? I have heard that it sells fish."

Sonia's eyes widened and twinkled with a silent mirth that quickly passed. Osborn started as if stung and transfixed the orderly with an incredulous glare.

"Sells fish!" repeated Osborn in a voice of scorn. "Is that the sum of your information? Of all the fish that are caught and sold in the world, we, or our coöperatives, handle more than twenty per cent. Our packages marked with the crown and trident are known from pole to pole. At every meal you undoubtedly consume some of our fish flesh, shellfish, pastes, jellies, or condiments. Your sugar and bread, your fruits and vegetables may have come from fields that flourished because of our fertilizers.

"It is probable that the salt on your table was extracted from the sea by our refineries. Your dispensary certainly contains iodine, cold-liver oil, gland extracts, and vegetable drugs of marine origin bearing our label. It would be surprising if you are not partly clothed with our kelp cellulose; you may even carry a handkerchief woven of sea silk. Possibly you are shod with our leather from sharks or rays. The telephone at your elbow may contain copper from one of our submarine mines. The pearl buttons of your shirt——"

Here Sonia interrupted this amazing outburst, to which the orderly listened aghast. "That carved ivory fountain pen you are holding—I made it myself from a bit of narwhal horn," she smiled. "The gold band around the top came

from a bar of bullion out of a sunken wreck off the island of Martinique."

At this opportune moment there entered a guide, a lithe and youthful señorita resplendent in white silk—cap, tunic, knickers, and hose—and sandals of white leather.

"Conduct these people to this room," murmured the orderly, handing her a card and passing his hand across his eyes dazedly. As Osborn and Sonia departed he breathed an exclamation in highly idiomatic Castilian and of possibly profane significance.

"WE WERE TOLD that Señor Ogelthorpe is laboring under some sort of delusion," remarked Sonia to the guide, as they shot upward to the forty-seventh floor.

"Yes, poor man," the girl replied compassionately. "He thinks himself another person and does not believe he is in Havana. He thinks he is somewhere on an island—I do not know where. Dr. Lemoyne is with him and has guided him around his room so that he may feel of the walls and furnishings. Also, he was conducted to an open window, where he could hear the music from the streets and smell the fragrance of the acacias. He is partly convinced, but much bewildered."

They found Ogelthorpe sitting up in bed clad in yellow silk pajamas, his eyes still sealed by the adhesive band of green. A small bamboo table bridged his lap and bore his breakfast, consisting of the quarter of a Ponderosa peach, several rashers of hypertrophied pompano with acidulated and fruit-flavored marine jelly, buttered bran muffins, and a cup of kaffina. He had refused to allow himself to be fed and was just concluding his repast with cautious, touch-guided movements.

The room was windowless and lighted by luminous flower patterns on the ceiling. On one side of the bed stood the telephone cabinet; on the other, a cluster of six chrysanthemum dandelions, whose huge blooms the size of a man's head seemed to fill the room with vivid golden light, were radiant in an ebony glass floor vase. Dr. Lemoyne, a tall copper-skinned Creole with an abnormally high forehead, alert brown eyes, and highly mobile features, rose as the visitors entered, from the collapsible seat attached to the foot of the bed.

"It sounds like Havana and it smells like Havana," the convalescent was saying. "Where else would one hear this 'Queen of the Islands' tango broadcast in the streets and find the air scented with acacia blossoms? But if that is where I am, then this man Ogelthorpe is either somewhere in this building under the name of Wilkes, or he is dead on the bottom of the Caribbean Sea, where you say he fell off a cliff. I don't know how you got us mixed, but it is quite plain to me that you have done so."

Dr. Lemoyne exchanged brief greetings with Osborn and Sonia, who ensconced themselves in folding chairs that let down from recesses in the wall.

"I hear two more people in the room," asserted Ogelthorpe. "Who are you?"

Sonia first essayed a reply. "This is Sonia. Does that recall anything to you?"

"Only that I am told that you sent some flowers, for which I thank you. Sorry I can't see them. But tell me," he said anxiously, "are you married to this Ogelthorpe?"

"No, not even by term marriage. I'm merely your sister."

"You mean you're Ogelthorpe's sister. My only living female relative is an aunt who runs a tourist hotel in Baffin Land and never comes south. But there's another here. Who are you?"

"My name's Osborn," responded that person. "I'm your assistant chief in the Pest Eradication work of Submarine Products."

"Don't remember ever hearing of you. I may have read of you in the Weekly Bulletin, or even may have heard you on the air, but don't recall it. However, you and I ought to be able to clear up this damned nonsensical confusion of Ogelthorpe with me. Do I resemble Ogelthorpe?"

"The resemblance is identical."

"Humph! That makes it easier to understand. But it's odd that the Personnel Office hasn't noticed our photographs in the files and published them in the Weekly Bulletin, as they have certain other doubles."

"There's an idea!" exclaimed Sonia. "Why not phone the Personnel Office and get data on Wilkes?"

"Praise be to Allah! Now we commence to see daylight!" cried Ogelthorpe. "Get on the wire, some one."

"ONE MOMENT," interjected Osborn. "You say that you're not Ogelthorpe, and yet you speak as if you were connected with Submarine Products. How is that?"

"Haven't I mentioned that?" queried Ogelthorpe. "Of course I am—have been for years—in the Exploration Section, with my present base of operations at the Panama station. Dr. Lemoyne tells me that Ogelthorpe had been operating out of Miami for several months. But let's get this phone call started."

"You are inspired indeed," Dr. Lemoyne approved, nodding to Sonia. "And when the Personnel Office informs us that Wilkes does not exist, it will demonstrate to our friend Ogelthorpe that I am not mistaken in saying that he has simply developed a secondary personality as the result of shock—something not unknown. This secondary self has submerged his real self, but not completely. The latter rises to the surface here and there, like islands, in the form of fragmentary memories."

He paused, eyed Ogelthorpe keenly.

"Very good," calmly remarked that extraordinary individual. "Your explanation has but one fault: it's all wrong. You can't talk me out of being Stephen Wilkes. Is some one going to telephone?"

"Before we do that, my friend," said Dr. Lemoyne, "I suggest that you tell us something of the events which you believe preceded your arrival here. Then we can make our request for data more definite."

"As to that, I shan't tell you what I *believe,* but what I *know,"* was Ogelthorpe's emphatic retort.

A brief, attentive silence followed, while he hesitated reflectively before speaking.

"About ten days ago, counting the four during which I am said to have been sleeping," began Ogelthorpe, "the Exploration Section of Submarine Products' research department sent out a party of fifty from Panama in the submarine *Grampus,* to make a survey of the waters surrounding the Galapagos Islands and the accessible parts of the islands themselves. We believe that they may be made aquaculturally productive. The ship is commanded by Captain Alan McLaren and the expedition is directed by Arnold Wainwright. Now tell me that they don't exist."

"But they do," agreed Osborn. "I know the ship and the men very well, and so do you; but I know nothing of the expedition. I might add that ten days ago you were not in Panama but were flying at an altitude of ten miles somewhere over the South Atlantic, en route from Port Enderby to Rio de Janeiro."

"I haven't flown the Antarctic Super since last year, but I'll not argue now," declared Ogelthorpe. "I was saying that we set out to survey the Galapagos waters. Wainwright put ashore twenty men and about forty tons of materials and machinery, together with camping equipment, on Albemarle Island, to build a permanent base. He used the *Gram-*

pus' metal drig, as the surf was too heavy to land conveniently any other way than by air. We left them putting up tents and assembling a two-thousand-horse-power heliodyne plant and a sea-water distillery. There's plenty of sunshine but not much water on any of the Galapagos.

"THEN the *Grampus* went on and commenced echo-sounding around Indefatigable Island. The Hydrographic Survey of Ecuador had told Wainwright —you know the Galapagos Islands belonged to Ecuador before the United States accepted them in lieu of part interest on a loan—and I suspect that Submarine Products' influence was back of that—that since 1985 there had been extensive elevations of the sea bottom around Indefatigable. And banks and shallows are some of the things we are particularly looking for in our aquacultural projects.

"All the islands are volcanic—seldom actively so, but of volcanic origin. Indefatigable Island is a volcanic cone, a pile of cinders and clinkers of lava with a big extinct crater in the center and a zone of sparse vegetation along the shore. No one had ever been inside the crater before we came.

"The drig tried to make air photos of its interior, but a cap of rain clouds hangs over it nearly all day and clears away toward evening; and when the drig approached, the air was found to be turbulent and dangerous as far up as it could go. So it came away without any pictures of the crater's inside. None of us imagined that there was anything there worth risking the drig and its crew to see.

"That rain cloud was a curious thing. It would form every morning as regular as a clock; there would be frequent flickerings of lightning but very little thunder; and at intervals during the day one could see, with binoculars, the rain falling copiously on the upper slopes of the cone. Yet there was no visible drainage into the sea, so we presumed that the water percolated down through fissures in the lava.

"The day after the drig's unsuccessful attack on the crater we continued echo-sounding, cruising slowly at a constant depth of five fathoms to avoid the waves. The echo-sounder corrected itself for our depth. Wainwright and I were in the subsurface navigating room in the ship's forekeel, with Captain McLaren. Hill was taking the soundings while we kept a lookout from the forward ports.

"We could see nothing but the clear, green water illuminated by the bow floodlights with thousands of luminous living specks darting about in it like gnats in a sunbeam, and the undulating upper tips of a forest of dark-red algal streamers that reached up from the blue-black mystery below the range of the lights. A vast shoal of small fish passed and repassed through the glare like a flight of silver arrows.

"Then we saw no more of the red algæ and there was nothing below us but liquid darkness. Hill reported that the soundings had increased from forty fathoms to over a thousand—more than a mile—indicating that the bottom went down suddenly and precipitously.

"He surmised that we were over a profound crevasse in the ocean floor, as the echoes were of a confusing, multiple nature, suggesting reverberations in a deep, narrow canyon. It was impossible to estimate the exact depth, but it was obviously very great. After we had progressed about half a mile, a depth of forty fathoms was again indicated and Hill's surmise was thereby verified.

"By cruising back and forth it was soon demonstrated that the chasm was at right angles to the coast line of Indefatigable Island, and we slowly traced it back toward the shore. It did not end at the shore. The basaltic cliffs that formed the submarine coast of the

island had been rent apart, and we cautiously nosed in through this gateway and into the big fiord that lay beyond. We followed this fiord into the island for about ten miles. The echo-soundings showed a slowly decreasing depth until it was not more than one hundred fathoms.

"WAINWRIGHT ordered Captain McLaren to take the *Grampus* down so that we might have a look at the bottom. It was almost completely barren —crags and gullies of black, naked, pock-marked lava—horrible scenery, like an uninhabited portion of hell. And in all the crevices and depressions were drifts of yellow sand.

"It was then that we first noticed the occasional particles of some substance that glittered in the glare of the floodlights, sinking rather rapidly through the waters around us. Wainwright at once remarked that the rapidity of their sinking indicated considerable weights, and opined that they were grains of metalliferous sand washed from the ledges of the fiord by the waves. Then we rose to the surface, opened the forward conning tower, and went on deck.

"The walls of the fiord were enormously high; a mere thread of gray sky was visible overhead. It seemed as if we were floating on a subterranean river in a high, narrow, winding cavern with splintered, black basaltic walls which rose sheer from the water's edge without ledges or beaches. The black walls and the meager gray light filled the place with an almost palpable gloom.

"We were so far from the mouth of the fiord that there was no surf whatever, only a gentle rise and fall of the water that moaned and sighed strangely in some hidden crevice of the basalt, waking echoes that were even stranger.

"Our voices produced such rumbling reverberations that we spoke in whispers, and even they were caught up and transformed to hoarse hissings far overhead. An occasional spray of fine mist descended upon us from the ribbon of leaden sky, indicating that we were under the edge of the island's cloud cap. The fiord was not shown even on the 1985 charts of the Ecuadorean Hydrographic Office, so it was obviously the result of some recent disturbance.

"Submerged again, we did not encounter the falling particles a second time until we had sunk to fifty fathoms. Evidently they came from a submarine source. The bottom was now about ninety. There were a myriad tiny, brilliant motes sinking rapidly through the water in all directions as far as we could see, sparkling with a reddish-yellow luster like crystals of golden snow.

"Almost at once some one phoned from the camera room, where they were photographing the bottom by UV light, and asked if we had noted the rain of sand. I phoned the chemical laboratory, only to find that they were already observing it and had collected a sample. They said that it undoubtedly contained a heavy metal and would call again as soon as it had been examined in the spectroscope.

"THE precipitation of sand grew heavier as we progressed, and soon the chief engineer phoned us in great agitation from the turbine room, to say that the sand was clogging the turbines and that the motors must be stopped while the trouble was repaired.

"On the heels of that the chemical laboratory called us, in some excitement, to state that the sand contained a very high percentage of gold and might prove to be almost pure metal. Telephones were soon buzzing all over the ship.

"But see here!" Ogelthorpe interrupted himself abruptly. "How about telephoning to the Personnel Office?"

"I'll call them," said Osborn, moving toward the cabinet. "I know whom to call and they know me. I'll ask if there is anything on file with regard to

Stephen Wilkes, stationed at Panama with the Exploration Section, and now thought to be serving with an expedition to the Galapagos Islands."

"That's the stuff!" exclaimed Ogelthorpe, and Osborn proceeded to dial his call.

"They will say, of course, that there is no record of any Stephen Wilkes," remarked Sonia aside to Dr. Lemoyne, while Osborn seemed to experience some difficulty in reaching the individual he wanted.

"We shall see," returned Dr. Lemoyne.

There was silence as Osborn made his inquiries and then waited tensely. After the lapse of a minute or two came the indistinct murmur of the reply, and Osborn started uncontrollably. He rose, wearing an expression of stunned amazement.

"The Personnel Office at New York says"—he began, and hesitated in the midst of an absolute stillness—"that Stephen Wilkes has been employed by the Exploration Section for six years and is now stationed at Panama City. They have no official report of his movements later than last month, but are informed that an expedition to the Galapagos Islands was contemplated and that Wilkes would probably be included. They have phoned Panama City and we shall hear from there very shortly."

IV.

"WELL, what have you to say to that?" demanded Ogelthorpe triumphantly. "Doesn't that prove that I am Wilkes?"

"It proves that Wilkes does—or did—exist, but does not prove that you are he," remarked a new voice from near the door, toward which every one, save Ogelthorpe, turned in surprise and beheld Dr. Feng in the act of exhaling a cloud of cigarette smoke. She had discarded her uniform for loose trousers and tunic of indigo-blue with a broad edging of gold. Her close-cut and inky hair clung to her scalp like a coating of glossy, black enamel.

"I could not come sooner," she continued. "I heard Mr. Ogelthorpe telling of the rain of sand, but nothing before that. I wish to hear more."

"I know that voice," said Ogelthorpe. "You were the first person to inform me that I am not myself. But tell me this: If I am not Wilkes, how can I know what he was doing up to four days ago?"

"Perhaps you do not know; you may merely imagine," Dr. Lemoyne pointed out. "At any rate, continue. We also wish to know what Wilkes was doing four days ago."

"To begin where I left off—the disabling of the *Grampus'* turbines—takes us back six days," resumed Ogelthorpe. "Our first thought was to return to the surface and get the repairs under way. Then, when Wainwright was told that it would be at least half a day before the work could be completed, he suggested that the three of us take to the bottom for a few hours and search for the source of the golden sand. We would be in constant touch with the *Grampus* by radio, and the ship could readily submerge and return to us, although she could no longer navigate horizontally.

"At the point where the *Grampus* touched bottom to put us off, the depth had further decreased to fifty fathoms. It was a matter of minutes until we were in our armor and standing on a massive slab of basalt under the swell of the ship's hull. We heard the dull throbbing of the pumps emptying her ballast tanks as she floated diagonally upward and vanished in the dark, upper waters.

"It is both cold and dark at fifty fathoms, and at this particular place it was abnormally cold. We turned on our lamps and our heat immediately."

"Heat! Do you mean that your armor is heated inside?" queried Dr. Feng.

"We wore one-piece coveralls with socks and gloves, of electrically-heated fabric like flying suits," explained Ogelthorpe. "Our energy came from the *Grampus* via a power beam which was kept trained upon us. If we got out of range of the beam we turned on our batteries—not the antiquated, uranium type that you say made such a mess of Ogelthorpe, but dry batteries like small editions of airplane power batteries."

"That part is true enough," remarked Osborn aside to Dr. Lemoyne.

THE NARRATOR went on. "I said that the water was abnormally cold. The inner surfaces of my eye ports were coated with glycerine to prevent them from clouding over with moisture from my breath, but I noted that at a few spots where the glycerine had not been applied, fronds of frost were forming. The ocean temperature was below the freezing point of fresh water."

"But the Galapagos Islands are directly on the equator!" expostulated Osborn. "Even the Humboldt Current at fifty fathoms wouldn't be that cold there!"

"I know that, too," retorted Ogelthorpe. "I'm telling you the facts as we found them.

"The bottom of the fiord was a chaos of basalt blocks of all sizes, from pebbles to pyramids, and we were forced to clamber over and under and around them, following a tortuous path which sometimes led us clear out of the zone of falling sand.

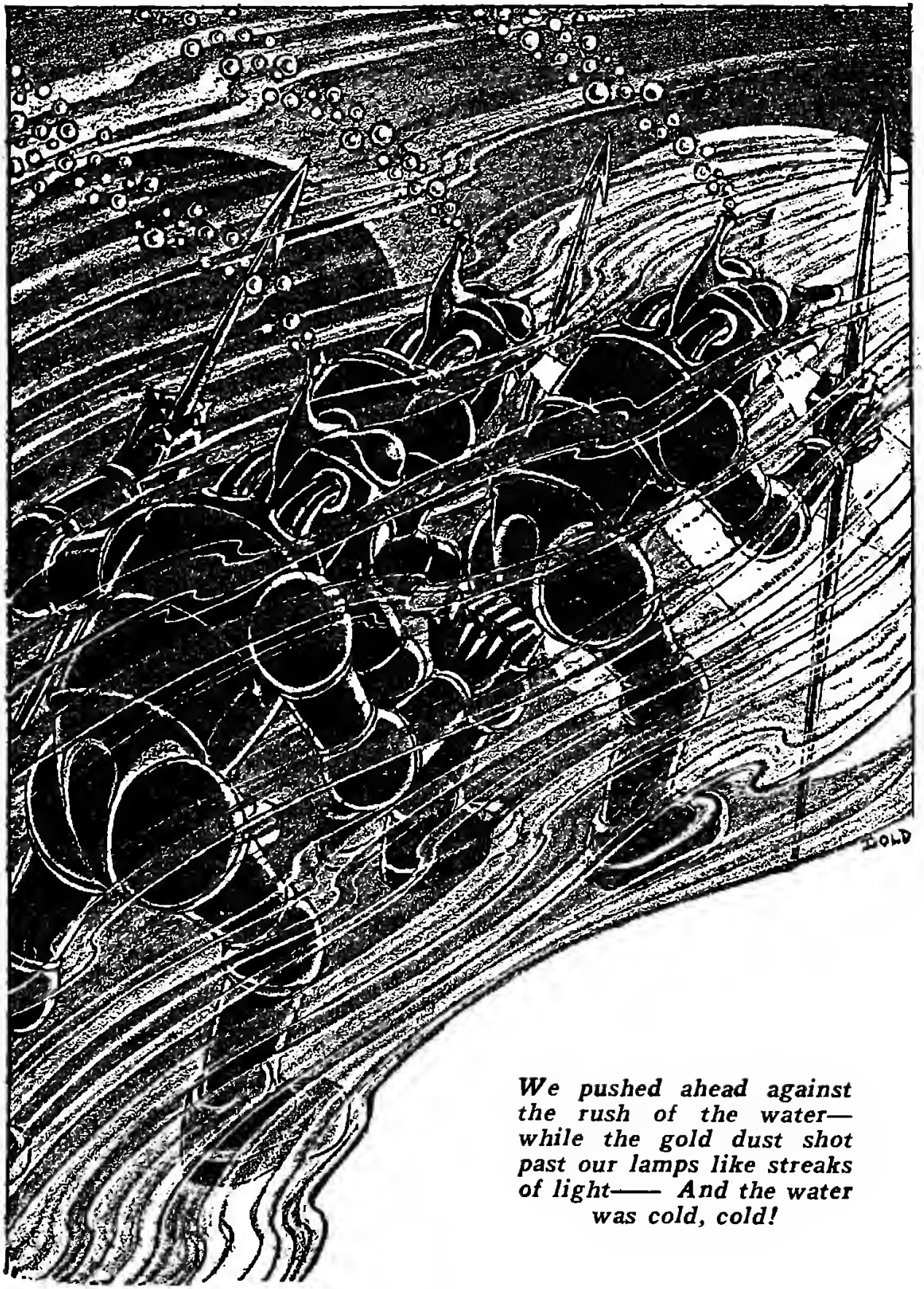
"We came to a place where the fallen blocks had formed a sort of giants' stairway; it had a crudely artificial appearance, like part of a neolithic ruin. While we were laboriously climbing these huge stairs we were brought to an abrupt, temporary halt by the appearance of two glowing disks of baleful blue-green, close together, on one of the higher steps just beyond the range of our lamps.

"Advancing cautiously, we saw a big octopus standing partly upraised on its tentacles. The disks were its eyes. Then another pair of green disks appeared behind and above it, and then others among the tumbled fragments on either hand.

"As we approached the brute it changed color several times with bewildering rapidity; its body commenced to puff and swell, and warty excrescences stood out upon its gelatinous skin. Then it flattened out and *poured* itself toward us, cascading swiftly down the giant stairs like a great, malignant, green-eyed blob of viscid liquid. We all carried electric lances, and when it was near enough, Wainwright punctured it between the eyes and let fly with five hundred volts. It tied itself into a thousand knots and died, and the others seemed to sense danger and disappeared.

"At the top of the stairs we came out on a comparatively smooth sloping area. We were now somewhat nearer the surface and a deep-blue twilight filtered down to us. A strong current raced downhill against us and the golden grains swirled past upon it in glittering swarms. We phoned this information to Captain McLaren, who informed us in turn that the chemists reported the 'sand' to be nothing less than minute flakes of pure gold. Then we heard the skipper curse and the phones went dead. After a moment his voice was audible again, saying that an electrician had blown the fuses in the main power circuits while working on the turbine repairs, but that nothing serious had occurred.

"Pushing on against the gold-laden current we soon discovered a remarkable object—a shattered section of a huge, cylindrical conduit partly buried among the black, glassy chunks of basalt. It was made of a deep-purple material that rang like metal when we struck it. A



We pushed ahead against the rush of the water— while the gold dust shot past our lamps like streaks of light—— And the water was cold, cold!

little farther on we encountered similar fragments. We attempted to communicate with the skipper, but in that very instant our phones went dead again, and the power beam was also cut off. We switched on our batteries and went on, presuming that another minor accident had occurred.

"THEN, at last, we came upon what might be called the source of the golden stream, but it only increased our amazement and curiosity. We were confronted by a low bluff of vitreous black basalt, and at its base the stream gushed with a whirling motion from an opening which we at first took to be the mouth of a cavern. But it was not the mouth of a cavern. It was an artificial opening, the splintered end of a huge tube projecting from the face of the bluff, the end of the conduit of which we had already discovered fragments, and it was no less in diameter than—than the Key West-Havana subway."

Bzzt! Bzzt! from the telephone. Osborn strode to the cabinet and touched the switch of the speaker so that all in the room might hear.

"Garvin of Submarine Products, at Panama, speaking," announced the instrument. "The Personnel Office phoned me to call Osborn."

"This is Osborn."

"You were inquiring about Stephen Wilkes?"

"Yes. We have a man here who says he is Wilkes."

"That is not very probable. Wilkes went on an expedition to the Galapagos Islands nine or ten days ago."

"What ship?"

"The submarine *Grampus,* under Captain McLaren."

"Is Wilkes still in the Galapagos Islands?"

"Well—ah—he probably is. At least we think he is."

"Don't you know?"

"Well, as a matter of fact, we don't know just where he is. Neither do we know what's happened to the *Grampus.* Our last word from Captain McLaren was about a week ago. He left twenty men on Albemarle Island and then disappeared—ship, Wilkes, and all. The men on Albemarle Island did not begin to worry until a couple of days had passed and then radioed that something had happened to the ship. We sent out a party in a sea glider at once, and the submarine *Dolphin* followed. Do you believe that this man you have there is really Wilkes?"

"No. I know he isn't. He's merely out of his head. I'll have a typewritten report sent to you by telephone. Call this same number if anything develops during the next half hour."

Osborn returned to his seat.

"Of course, I merely imagined all that," Ogelthorpe said sarcastically, "and by a mere coincidence my imaginings happened to correspond to real events."

"No, that is scarcely credible, but it is possible that you knew of the projected expedition," countered Dr. Lemoyne. "You may even have talked with Wilkes."

"Ogelthorpe has never talked with me; I don't know him," Ogelthorpe stubbornly denied.

"You have forgotten it," suavely insisted Dr. Lemoyne. "Why, you have forgotten even that you *are* Ogelthorpe."

"Why argue about it?" that individual asked wearily. "Now what was I saying before the phone buzzed?"

"You had just discovered a sort of conduit that discharged a whirling stream of gold-laden water," prompted Osborn.

"OH, YES. I said it seemed to be made of a material like purple metal," Ogelthorpe continued. "Well, we walked and crawled through it until we arrived at the other end, a matter of about two miles, as I judged it."

"But that was dangerous!" exclaimed Dr. Feng.

"Well, perhaps," conceded Ogelthorpe doubtfully. "Although I don't consider it nearly as dangerous as sliding down a glacier and flying off the side of a mountain in a toboggan plane, the way people do at the antarctic resorts. I did that once and that was enough. I feel safer under water than I do in the air, or in most places on land. Although the place I am speaking of proved to be sufficiently disagreeable.

"The interior of the conduit was grooved spirally like an enormous gun barrel, which was all that enabled us to progress after it commenced to slope upward. At first it was horizontal and we pushed ahead against the rush of the water, while the gold dust shot past our lamps like streaks of light, like snow in a blizzard. And the water was cold, cold! I could feel the chill of it with the heat on full.

"Then the upward incline began and we crawled on hands and knees, gripping the grooves of the rifling. Incidentally, this rifling caused the water to rotate as it flowed and tended to roll us over sidewise. We hooked our lances to our belts and let them trail along beside us."

"But why risk one's life so madly, crawling through a horrible submarine tunnel, when there were already tons of gold outside for the taking?" Dr. Feng demanded.

"It was not so much the gold that drew us on," replied Ogelthorpe, "as the enigma of the conduit itself. It was obviously a marvelous piece of engineering and indicated that Indefatigable Island was not—or had not always been—the almost lifeless desolation that previously it had been considered. What was at the other end? That was what we wanted to know. We expected to emerge somewhere inside the crater, but did not expect the distance to be so great as it proved.

"After we had crawled for ages, it seemed, I noticed that something was wrong with the air. My acrophores were not working properly. My breathing became difficult and my head ached; Wainwright and Hill experienced the same thing. The farther we went the worse it became, and we speedily realized that unless we soon reached the surface we would never reach it at all.

"JUST as our gill motors stopped running and burned out their armatures, we came to a branching of the conduit. The flood of gold-laden water was coming in from one branch; the water in the other branch was clear and filled with a bright-green radiance of daylight that shone in only a short distance away.

"We blundered toward the daylight and crawled out on the bottom of an obviously shallow body of water, a dazzling yellow glare by contrast with the gloom of the conduit. We stood up and lumbered on, ankle-deep in golden silt, our lungs bursting for air and with flashes of fire and streaks of blackness dancing before our eyes. It seemed that we should never find the shore.

"Then we went up a seemingly endless incline and our helmets burst through the surface. I had a dizzy, whirling glimpse of a golden beach with naked, brown, glistening human figures upon it, scattering in all directions at our appearance. A vivid-green jungle loomed beyond the beach, as though seen through a fog. A misty, blue mass as of some vast building upreared still more indistinctly beyond the strip of jungle. I saw all this through the veil of a blinding headache, as I collapsed at the water's edge like a load of old iron. Wainwright and Hill fell likewise, with heavy clanks, near me.

"My hand shook so that I could scarcely unhook the spanner at my belt and open an eye port. I lay in a half faint, inhaling the air in great gasps."

V.

OGELTHORPE paused in his narrative, made the gesture of one who reflectively runs his fingers through his hair, and demanded suddenly, "Who shaved my head?"

"You have had a head shave regularly every other day for years," replied Sonia.

"Horns of the devil! Ogelthorpe again!" he exclaimed. "Tell me this: Did Ogelthorpe by any chance wear a cork leg or have any other defects?"

"You are—that is to say, Ogelthorpe is—a distance swimmer of some note," Osborn answered. "Also, he finds great pleasure in winter sports and plays the violodeon with more than average ability. Does that answer your question?"

"Yes, but I don't care for winter sports and I'm not a musician," responded Ogelthorpe crossly. "Moreover, how can I resemble Ogelthorpe if he shaves his head and I don't? I never have admired this modern craze for artificial baldness."

"You are undoubtedly the same man whose photographs were given me for use in reconstructing your face," interposed Dr. Feng.

"Why, confound it! You've *made* me look like Ogelthorpe!"

"Not at all. I remodeled only the left side of your face and a portion of your lips, and you were obviously the man of the photographs before that was done."

"Hm-m-m. Do you happen to have a photograph of Wilkes?"

Osborn sprang to his feet and toward the telephone.

"No, we have no photograph of Wilkes," said Osborn, "but I'll have the Personnel Office phone one to us immediately."

"There is telephote receiving room in this building," said Dr. Feng, as Osborn manipulated the dial. "Have it sent there."

"Now tell us what happened after you came out of the water," requested Osborn, when he had completed his call.

"When I had recovered sufficiently to sit up and look around, I saw that we had come out inside the crater, as we had rather expected to do," Ogelthorpe proceeded. "Now that my eyes were adjusted to the daylight, it did not seem as brilliant as it had. It filtered through a uniform gray pall of cloud from which a fine drizzle of warm rain was falling. At intervals there would be a glimmer of lightning and a muffled roll of thunder.

"I was seated on a beach of gold dust, my feet in the waters of a lake as smooth as a mirror. Several red-footed boobies skimmed, squawking, over its misty surface. Inclosing the lake, the ramparts of the crater loomed through the haze of rain and towered into the cloud ceiling. And beginning where the yellow beach ended and climbing halfway up those rocky walls was a mat of dense, verdant, steaming jungle, richly green and luxuriant as only a rain forest can be. That is, it looked like a jungle, but it wasn't. I'll explain myself in a moment.

"Hill had also opened an eye port and was sitting up, but Wainwright lay motionless, a spanner in his hand, evidently unable to exert himself further. Hill and I hastened to unscrew his eye ports. His face was purple and he was unconscious. We removed his helmet with all speed, extracted him from his armor, helped each other out of our own, and brought him round by artificial respiration.

"We kept on our coveralls—not for the sake of warmth, we didn't need warmth, and they were disconnected from the armor then anyway, but because they were waterproof.

"AS SOON AS Wainwright was on his feet we examined our aerophores. We found the tubes and pump cylinders

entirely filled with gold dust and salt crystals. I can't account for the salt crystals, except to surmise that the water in the conduit was a saturated brine. When the pumps had stopped, the motor armatures had burned up. In short, our aerophores were absolutely done for; nothing but a trip to the shops could put them right again. Our little emergency kits of tools were entirely inadequate for the complete overhauling that was necessary.

"Clearly, we could not return as we had come. The only alternatives that we could think of were either to climb out of the crater and hope that some one would see us and take us off the island before we starved to death, or to stay inside the crater, where we could probably survive indefinitely until some one came after us.

"But why should any one look for us inside the crater, we asked ourselves, when no one knew we were there? Also, all previous explorers had failed to scale the outside of the crater, so what assurance had we that we could climb out?

"While we gloomily meditated on these various unpleasant possibilities, as we sat on the beach beside our armor, Hill suddenly brightened.

"'See here!' he exclaimed. 'Every one aboard the *Grampus* knows that we went to investigate the golden sand. Therefore, as soon as the turbines are fixed, and since no more will have been heard from us, the *Grampus* will follow our probable trail to see what the matter is. Captain McLaren will discover the outlet of the conduit, and then——'

"'Yes, go on. Then what?' asked Wainwright sourly.

"'Why, he will immediately suppose that we have gone into it and wait for us to come out. And when we don't come out he'll send a party in after us.'

"Wainwright growled, 'In the first place, even if they find the conduit, no one but a moron would suppose that we would crawl into such a devil of a hole. In the second place, what if any one did come up through the conduit to find us? The same things would happen to them as to us, and then there would be three or four more of us sitting here wondering what to do next, or possibly laid out with their hands crossed. And what good would that do us?'

"Wainwright had barely finished speaking when out of the corner of my eye I saw a movement among the giant ferns that bordered the beach, and then something red sailed through the air. I cried out and dodged. The object fell on the beach beside me. It was a wreath of great crimson, waxen flowers which looked like overgrown morning-glories.

"That reminded us that we had glimpsed human inhabitants on the beach as we emerged from the lake. I remember wondering whether the flowers were a bouquet of welcome or a ritual garland for the prospective sacrifice.

"MY DOUBTS vanished when I saw the cluster of small brown folk who now timidly crept from among the fern fronds. Not one of them was over five feet tall and most of them were somewhat less than that. As clothing they wore two big leaves, like plantain leaves, one fore and one aft, and wreaths and garlands of flowers. The women wore anklets of flowers, and all were barefoot. They were slender and well-formed, with only moderately thick lips, shapely noses, small ears, and a great mop of blue-black hair bound up in a sort of loose coiffure with flower chains. Their eyes were large, black, and limpid like a marmoset's, and fairly sparkled with excitement.

"It was evident they were devoured by curiosity and irresistibly impelled to draw near and investigate us, but at the same time all of them were endeavoring to keep behind some one else. This caused much jostling and milling round

and round as they hesitantly advanced. Several chubby youngsters, popeyed with excitement, appeared lurking among the ferns; they were adorned with orchids in their hair and behind their ears, and a few were draped with flower necklaces, but that was the sum of their raiment. The whole company was drenched and glistening with rain, but it seemed a customary condition; apparently no one minded it.

"When they were halfway across the beach, they paused, and a girl stepped forth. Instead of a leaf apron she wore a kilt of long, pendent clusters—a botanist would have called them racemes—of intensely blue bell-shaped flowers. The same flowers formed her anklets and were twined in her hair. A thin band of gold, set with five blue stones in front, encircled her head and she carried a staff that appeared to be of clear glass, divided at the top into five wavy, pointed branches like flames.

"That was surprising enough. We rose to our feet and the delegation sank to their knees and bowed low, so that their flowery hair tumbled forward on the golden sand. Then the girl peered up through her hair and commenced to speak a corrupt Malay dialect. And that was astonishing."

"You understood her?" asked Sonia.

"Fairly well even then; better later on," replied Ogelthorpe. "Nearly all my work has been in the Pacific, principally among the southern islands or along the coasts of Malaysia."

"Ogelthorpe wouldn't know Malay from Armenian," remarked Osborn aside to Dr. Lemoyne.

"What did this flower-bedecked lady say to you?" Dr. Feng inquired.

"Well, at first I thought I was misinterpreting her," said Ogelthorpe slowly, "but she said, in effect, that they were our faithful servants and had been waiting for us a long time—literally, 'many generations.' I decided that that was simply exaggerated politeness, as did Wainwright, who also speaks the language. We had to translate for Hill's benefit.

"THE GIRL informed us that her name was Shadow Flower, and then became practically incomprehensible. She seemed to say that she welcomed us on behalf of 'the other keepers of the cloud fire.' Wainwright insisted that it was 'storm fire,' which he interpreted as 'lightning.'

"She said further that 'all our servants rejoiced that we had come to claim that which was ours, 'as foretold by the Speaking Stone.' We could make nothing of that, except to infer that Speaking Stone was the name of the local soothsayer. But at that moment we were not greatly interested in what we supposed were native superstitions, so I asked as best I could if there were a way out of the crater.

"My question did not register well at first; Shadow Flower was perplexed by my clumsy handling of her peculiar tongue and I had to repeat several times. Finally, she comprehended and replied in a surprised manner, 'Men may go only through the house of the lightning, but what is that to you?' I erroneously interpreted this to mean that the road lay through the clouds—that is, through a pass somewhere in the crater's rim. That encouraged us greatly.

"Wainwright now essayed a few words and asked for something to eat. He put the idea across at once by following his request with the classical gesture of pointing into his open mouth.

"This caused a little flurry of excitement in the delegation and some one cried out, 'They eat as men do!' Shadow Flower betrayed further astonishment, but said that their wishes were as our wishes.

"During this interview I had been holding the wreath in my hands.

Shadow Flower now arose, came toward us cautiously, and with an expression of mingled awe and determination took the wreath and threw it over my head, standing on tiptoe to do so.

"The wreath fell to my shoulders and Shadow Flower scurried back to the others, calling breathlessly for us to follow. Hill snorted and remarked that I made an ideal Queen of the May. Not knowing just what significance the wreath might have in the etiquette of hospitality among the crater people, I did not remove it."

A faint sound, indicating amusement, escaped Dr. Lemoyne. An expression of irritation passed over Ogelthorpe's features; he hesitated, and then continued:

"We followed Shadow Flower and her company into a tunnel of overarching ferns along a broad pathway of the granular gold, rimmed with olive-green stone. The ferns on either hand swarmed with a murmurous throng of the crater people, who paralleled our progress but still timidly kept their distance. Then the path ran between a pair of seven-foot hedges—clipped hedges—of plants with leaves like green bronze and magnificent with scarlet trumpet-form flowers a foot long, saturating the air with fragrance.

"We ascended a flight of steps of the green stone to a terrace of golden sand, bordered on one side by a green stone balustrade overlooking a sea of dripping giant ferns, and on the other side by an impenetrable growth of overhanging shrubbery like miniature weeping willows, the drooping leafy plumes mingling with pendent chains of intensely yellow blossoms. The golden petals were falling in showers upon the golden sand, and not one appeared less golden than the other. Everything dripped and trickled with rain and the air steamed. Our coveralls were rapidly becoming unbearable.

"Then up another flight of steps to another terrace and a fountain. The water spouted in twin streams from the double trunk of an elephantlike image into a crescent-shaped pool of cream-colored water lilies."

"BUT you are describing a garden, a garden in a hashish dream!" protested Osborn. "How could such things be in the crater of Indefatigable Island, of all places?"

"Heaven knows," replied Ogelthorpe. "But it's there. Beyond the fountain we crossed a parklike meadow, where a dozen or so giant Galapagos tortoises were leisurely stripping the leaves from a thicket of little shrubs. Some of the crater people, who were clipping another flowering hedge, dropped their shears and joined our retinue. We traversed a

grove of tree ferns and then halted in wonder.

"I mentioned seeing indistinctly a big building of some sort when we first emerged from the lake. Shadow Flower had led us directly to it.

"We were separated from it by a plaza about five hundred feet in width and paved with the same purple material that we had seen in the conduit. A bewildering tracery of white-and-gold lines overspread the purple plaza, all converging toward the base of a majestic flight of steps that mounted toward the building. You have seen the steps of the capitol at Washington. These are three times their height and are striped from top to bottom in three colors: purple, white, and gold.

"The edifice that crowns these steps is unbelievable, even while you are looking at it. It is too intricate for me to give you anything but the sketchiest idea of it; it is vaster than Angkhor Wat, more unearthly than the Taj Mahal. The façade has a radiate form, like a flower or a star cut in half and lying on its flat side. It throws out slender arches and flying buttresses that are like tentacles; they intertwine and describe loops. It is chiseled with filigree and drawn out into spires, and the white-and-gold lines curl across its purple surface in marvelous, swooping volutes that are like the maps of solar systems and the orbits of atoms.

"Shadow Flower alone preceded us across the plaza and up the striped steps. The other crater people fell behind and followed slowly. The complex façade towered up huger and huger, and stranger and stranger, as we plodded speechlessly upward.

"The central portal was a circular arch about eighty feet high at the center. We noted with only a slight increase of wonder—another strange thing more or less made little difference—that it was closed by a series of overlapping plates of white metal arranged like the leaves of an iris diaphragm.

"Shadow Flower struck the five prongs of her transparent staff against it. Instead of shattering like glass, they zoomed like a tuning fork. The metal plates quivered, they moved; they slid back with a gentle hissing. The door *was* veritably an iris semidiaphragm on a grand scale. In a few moments it was completely open."

"Do you mean that it was opened by the sound of this musical staff?" demanded Sonia.

"Well, what of it?" returned Ogelthorpe. "How about these trick apartments where you blow an individually tuned whistle to open the door? Nothing new or startling in that."

"What did you find inside?" Dr. Feng desired to know.

"WE HAD only a glimpse; we didn't have a chance to go in," replied Ogelthorpe. "Some one or something started to close the door as soon as it had completely opened. Also, there was a devil of a fight going on inside among a mob of the crater people. All of them wore golden headbands and kilts of blue blossoms, like Shadow Flower's, but they had torn off most of the flowers by the time we saw them and were still going at it tooth and nail.

"Part of the mêlée immediately flowed out and surrounded us. Some of the crater people tried to get at Shadow Flower and us, and the others kept beating them off. They knew nothing about the use of fists; they kicked and clawed and bit and pulled hair. There were no weapons in use. Shadow Flower's staff was snatched away to be seen no more. The crater people below in the plaza emitted wild yells and made a rush up the steps.

"I was surprised to see so much fight in such mild little people. A woman broke through our defense and seized

Shadow Flower's hair. I gave her a straight-arm punch between the eyes. She flew backward ten feet and slid twenty more, ending up inside the power plant. That startled the crater people. Our attackers fled inside just before the door came shut and our defenders withdrew to a respectful distance."

"You called it a power plant!" exclaimed Osborn. "Why did you say that?"

"Why, you see, just before we became involved in the fight, I looked over the heads of the combatants inside and saw——"

Bzzt! Bzzt! went the telephone.

"Damn!" cried Osborn, leaping toward it. "Osborn speaking," he snapped.

"Garvin at Panama City," came from the speaker. "Just now received word about the *Grampus*."

"Well, what about it?"

"Our submarine *Dolphin* found the *Grampus* riding helplessly at anchor in a fiord of Indefatigable Island with her turbines and radio out of commission. In repairing the turbines, an accidental short circuit burned up her transmitting tubes and they were trying to fabricate new ones in her shops when we found her. Until the radio was repaired they could only wait and hope to be found."

"Didn't they have a drig?"

"No. They left it on Albemarle Island."

"Was Wilkes on the ship?"

"No. He and two other men took to the bottom and haven't returned. We fear the worst."

"Who were the other two?"

"Their names are Wainwright and Hill."

("Ah!" triumphantly from Ogelthorpe.)

"What were these three men looking for?"

"It's rather fantastic. I'm almost inclined to think that Captain McLaren is temporarily unbalanced."

"Yes, but what was it?"

"Captain McLaren says they were looking for gold. As a matter of fact, he says the *Grampus* ran through a sort of golden zone and that her turbines were clogged with gold dust. Can you picture that?"

("Perfectly," murmured Ogelthorpe.)

"That's all very peculiar. It's just what this man we have here says."

"The deuce he does! And you say he isn't Wilkes?"

"No. Positively not. His name is Ogelthorpe."

"Let me see him."

Osborn revolved the upper part of the cabinet until the ocular pointed at Ogelthorpe. There was silence for a moment.

"He's no more Wilkes than I am," declared Garvin's voice.

"You're a slimy conspirator, just like all these other misbegotten sons and daughters of iniquity! Just wait till I get my eyesight!" shouted Ogelthorpe.

For a few moments the room was in confusion.

TO BE CONCLUDED.

An unbelievable—yet scientifically convincing—situation develops in next month's installment. Follow it through to its astounding solution.

ZERO AS A LIMIT

"Beta diminishes to nothing, you see——"

by Robert Moore

THROUGH the thin air of the stratosphere the lone ship knifed, keeping its wary vigil above the desperate Earth, ready to fight or flee. More often they fled.

Lieutenant Jan Grath sat hunched over the controls, his gray eyes scanning the void. Beside him, Iar Marto nervously fingered the trigger of the Z-gun, which would hurl, with the speed of light, an electric charge that would explode on contact.

Off to the southwest a blue dot flickered. The lieutenant saw it. He pushed the power bar forward and the rockets in the rear thrummed sharply.

"Zarlee patrol in sight," he spoke softly into the microphone beside him. "Will engage." For the benefit of the listener in the central base, he ran off a string of directions that would enable headquarters to locate the hostile ship.

"Ready, gunner?" he asked.

Marto nodded. His eyes ran down the telescope sight of the Z-gun. Through the 'scope he could barely see the blue flicker of the Zarlee ship.

"It's too far for effective aiming," Marto reported. "I can't hold him on the cross hairs."

"You'll be close enough soon enough," Grath growled, thrusting the power bar forward to the last notch.

The rockets exploded in a thundering blast of sound. The acceleration caught Marto, flung him against the padded seat, seemingly draining the last drop of blood from his body. He glanced at Grath, saw the face of the lieutenant was white and bloodless, and changed his mind. Acceleration could kill, but any Terrestrial pilot would thrust his power bar forward to the last notch if a lone Zarlee ship was in sight, and acceleration be damned.

"On your toes, gunner," Grath ordered through bloodless lips. "That ship hasn't seen us yet. The minute you can keep him on the cross hairs, you hold that trigger down. If you miss, the Zarlee will cut us into pieces with his needle beam." The lieutenant made a minor adjustment of the power load, and growled, "You better not miss."

"I—I won't."

"Train your sights. We're getting close."

Marto glued his eye to the sight. The blue globule was nearer, much nearer. The thin blue haze that was connected with the propulsive mechanism of the Zarlee ships—no Terrestrial scientist knew exactly how they operated—was dimly visible. The hull gyrated back and forth over the cross hairs of the telescope.

"Can you hold it?" Grath questioned.

"Not—not yet."

"Quit stammering, you fool, and lay that gun. You're as nervous as a cat."

"Yes—yes, sir."

IAR MARTO fought for self-control. Though he, in common with every other native of Mother Earth, vehemently hated the Zarlee, when it came to actually killing them some nervous kink within his mind made him flinch. It was not something that he could control, or explain. With the desperately embattled

The nose of their vessel was sheered off as if it had been cut by a mighty knife—— The Zarlee needle beam had struck——

Earth under strict military discipline and all able-bodied men conscripted, you did not explain to the commanding military that the sight of blood, even Zarlee blood, made you sick, not unless you wanted to stand with your back to the wall. Such an explanation would sound like cowardice. Court-martials had little time to bother about fixations.

"Gunner, lay that gun. We're almost within range. Snap into it. That ship is certain to see us any minute now. If we can't surprise the Zarlee, they'll blow us out of the sky. They can outfly and outshoot us. Lay that gun!"

Marto brought the cross hairs into line, held them there. They were centered dead on the Zarlee ship. Press

the trigger and a flood of disruptive charges would obliterate the enemy vessel. Press the trigger, you fool, squeeze it. Blast that ship out of the sky.

Marto squeezed. His fingers wouldn't work.

"Shoot, you idiot!" screamed Grath. "They've seen us, are starting to move. Shoot!"

Desperately, Marto tried. The cross hairs were centered dead; he had only to fire. But his muscles would not obey the orders of his mind. Perhaps his mind would not give the orders. He didn't know which. He turned a white, pleading face toward Grath.

There was a sibilant, hissing sound. The nose of their vessel was sheered off as if it had been cut by a mighty knife. The Zarlee needle beam had struck. Their ship faltered, swung dizzily in space, sloped down toward Earth. The stern buoyancy vibrator slowed their plunge. Grath and Marto—there were only two men on these tiny scout ships—were sitting on the edge of nothing. Their vessel had been knifed inches in front of them. Grath was holding his left hand. No, it wasn't his hand. His left hand was gone. With his right hand he was squeezing the stump of his left arm, trying to stop the spurting of a red fountain.

They floated slowly down to Earth. The Zarlee ship came up, prepared to capture them when they landed. The Zarlee took all the captives they could. They had a use for the bodies of humans. But the use they made of them was known, and they took few captives alive.

They hit the Earth with a stunning thud. The Zarlee eased to Earth near them, then darted rapidly away. Midway in flight, the ship exploded in a flare of white light. Marto looked up. Three huge Terrestrial battleships were knifing down the sky overhead, coming in response to Grath's report of their position. They were taken aboard.

Marto, white-faced and shaken, visited Lieutenant Grath in the hospital ward. Grath was swearing weakly. He wasted few words on Marto.

"What happened? Why didn't you fire?"

It was something you couldn't explain. Marto tried and failed. Grath must have sensed his meaning.

"Kid, that gun never jammed, but I'm going to say that it did. I'm going to recommend that you be sent back to the laboratories, where you came from. There's a streak of yellow in you a foot wide. It cost us a ship and me my left hand. You ought to be stood against a wall and shot, for cowardice in the face of the enemy. But we need every available man, and you may be able to do some good in the laboratories. Heaven knows you're no good at the front. Now get out."

THE MILITARY COUNCIL, plainly aware that Grath's report was not complete, hemmed and hawed. Finally, they accepted his recommendations, and Iar Marto was ordered back to the lower levels of Snarth, to report to Professor Thielpan, who was in charge of all experimental work.

Thin and gaunt, showing only by the fire in his eyes that he was alive, Thielpan growled, "You're a good worker, and as such I'm glad to have you. But the order sending you here indicates that your conduct up above was criticized. You will find we have no room for weaklings here. The survival of man on Earth demands that each of us do his duty, whatever it may be. If you falter here, I'll have you eliminated. That's all."

Iar Marto kept his chin up and his face straight. Let them call him a coward if they chose. There was no way to answer their accusations. They did not know it was not death that he feared, but killing. His fear of that was so violent that it left him a physical weakling.

In the deep levels of Snarth he took up life again. Here there was no danger, as yet. As long as the city held, the lower levels were safe. The only indication of trouble that seeped through from above was the tenseness in the air. Men worked and worked and worked, always against time. It almost seemed that time was a greater enemy than the Zarlee. Experiment followed experiment—some new weapon, a new defense. The technicians slaved hour on end, day on day, month on month.

Up above men begged them to hurry. "Give us a weapon to fight that needle beam," they begged. "Give us a ship that will fly as fast as the Zarlee globes. Give it to us quickly! Arnst, one of the hidden cities of the Appalachians, fell last week. There aren't many cities left. The twelve-year-old struggle between the Earth peoples and the invaders from dying Pluto has almost decimated Earth. Give us new weapons, quickly!"

The months dragged into another year, while Iar Marto slaved. He worked largely alone. The men in the laboratories shunned him, never spoke unless duty demanded. But, grudgingly, they admitted his ability.

Thielpan had clearer eyes. He wanted results, and he would have gone to the devil for help if he could have secured aid from that source. If he despised Marto, he kept it to himself. In recognition of his ability, Thielpan made Marto his first assistant. Marto didn't care. He had no reason to care, one way or another.

The year of 2841 dawned. The forces of Earth were being slowly forced back. The Zarlee seemed to reproduce faster than they could be killed. Scientists did not know exactly how the Zarlee reproduced, but they suspected it was by fission, where an old individual split into two new ones, each retaining all the knowledge and abilities of the parent. At any rate, though the warrior hordes of Earth had taken an immense toll of the pear-shaped Zarlee, it seemed as many remained as ever. There had been no new migration from Pluto.

Only eleven subterranean city states remained to the Earth peoples in 2841. They were scattered all over the globe. Man had been forced underground when the Zarlee came. He had dug deep, had learned to raise food in the depths. The entrance to the cities were ringed with Z-guns. No hostile ship could live in the air overhead. But neither could a Terrestrial ship hope to exist for long away from the protection of the forts.

2841 was a black year. The Zarlee blew out of the Earth one of the cities hidden in the Alps. A tremendous ship, loaded with thousands of tons of explosives, was launched from above the atmosphere, and guided by robots. It struck at the speed of thousands of miles an hour, penetrated to the depths, and exploded. The Earth tremor was felt over the entire globe. Next an Asiatic city went. Nine were left, their inhabitants numbering about three millions. Three millions left of the billions who had once inhabited the Earth.

THE NEWS, carried on the visaplates to the other cities, brought a feeling of hopelessness. It was only a question of time. But the men in the laboratories slaved harder, and Iar Marto slaved with them.

On the heels of the news of the destruction of the ninth city, there came to Marto a summons from Thielpan. He found the professor slumped over his desk, asleep. At the sound of his entry, Thielpan raised haggard, bloodshot eyes to Marto's face. He shoved a sheet of paper across the desk.

"Look at these and tell me what they are."

Marto ran a practiced eye down the rows of equations. He knew them by heart, to the final alpha.

"They're the equations of the force

field generated by our Z-guns. They demonstrate, mathematically, the creation of a force which unlocks intramolecular tensions, resulting in a terrific explosion taking place in any object in which the force field is concentrated."

As if he was weary beyond endurance, Thielpan lifted his head again from his arms to shove another sheet of paper across his desk.

"And these?"

Marto took the first series of expressions at a glance. He saw instantly that they were a variation of the fundamentals on the first sheet, except that they showed no resultant. He dived into the second line, the third, the fourth. As his mind tried to grasp the relationships involved, a growing pucker showed on his forehead. He sat down heavily in the chair facing Thielpan.

"I—I don't understand."

Thielpan sat up. His shoulders sagged and he answered in a thin, rasping whisper.

"You will understand, in time. Your job is to build the machine."

"But these equations apparently are the formula for the generation of a force great enough to split the Sun in a thousand parts. I see no way of controlling the force."

"The control is there, in the beta factor."

"But evolving these equations results in beta diminishing to zero as a limit. Your control soon reaches the vanishing point."

"Yes, and the generated fields collapse with it. There is no danger to anything but the control."

"What is the control?"

"You build the machine. I will supply the control. Here are diagrams describing the apparatus. Set the whole staff to work at once."

"But——"

"The commander of the defense force believes the Zarlee are preparing to bomb us. We have about two weeks. Our only hope lies in that machine. Go!"

"Yes, sir." Marto saluted.

Under Marto's terse orders, the jaded technicians cleared an upper chamber, brought immense power cables from the main generators, sheathed the walls with lead, and started setting up the complex apparatus described on the diagrams.

Days passed. The general staff of the defending forces conferred constantly with Thielpan. For the first time in years, Marto saw something like hope in their faces, hope mingled with fear. There was no question that the Zarlee were building another immense bomb. A tiny patrol ship slipped through their defenses and returned with the information.

BUT from what Marto was beginning to understand of the equations they were working night and day to express in copper and glass, in force and counterforce, in power coil and glittering oscillator, the besieged defendants of Snarth had a chance. They had more than a chance, given time.

Marto was beginning to understand the mechanics of those equations, and to marvel at the power of the mind that had evolved them. At the same time he knew there was a flaw in the equations. The diminishing value of beta meant only one thing. From the shape of mechanism he was devising, Marto suspected the logical answer to the diminishing value of this factor. He shuddered. If Thielpan, in devising this formula, had gone beyond space and time into hyperspace and hypertime, he had gone through a door that might open only one way. Marto wondered about the control Thielpan had promised. Wondering, he shuddered, shaken again by a rising fear.

But Thielpan, though he seldom left the chamber where the technicians were slaving, volunteered no information. He seemed to grow weaker and more irasci-

ble each day. The man never slept. Each passing hour he leaned heavier on Marto's arm. He seemed to be kept alive by the will to live, and little else.

Marto marveled at the man, and, marveling, admired. His admiration grew almost to worship. Here was a physical weakling; yet here was a man who was more than a man, who would never fail his duty. Marto, remembering Jan Grath and the needle ray that had sliced through their ship—it seemed years ago—visualized Thielpan in his place that fatal afternoon. Thielpan would have been stronger than any inhibition or fixation he might have. He would have overcome fear as he overcame fatigue, by the power of his will.

On the tenth day the device was almost finished. Workmen were gingerly testing various parts of the apparatus. Coils, condensers, the crystal-controlled oscillator, each was tested, and each functioned properly as an individual unit. Thielpan refused to test the entire apparatus.

"It will work," he said grimly. "Marto, go to my room and bring me the device you will find in my closet. Handle it carefully."

It was something closely resembling a headset, except that the twin pieces of metal were obviously not designed to fit over the ears of the wearer. The cord and the plug attached to it—— Marto knew where that plug fitted, knew the circuit it fed, knew that the frequency of that circuit was impressed on the master circuit, and he suddenly realized and was afraid that he had the value of beta.

WHEN he returned with the headset, he found the lead-lined chamber empty of technicians—with the exception of two who were setting up a visaplate—and filled with officers. The air was so thick with tension it could have been cut with a knife. Something had happened somewhere.

The first officer he saw was Jan Grath, now Colonel Grath. The news of this promotion had not filtered to the depths.

Grath was talking to Thielpan.

"There is no question about it," he was saying. "The Zarlee bomb is complete. Our patrol ship got through and saw it, and managed to radio us before it was knifed down. They were testing it fifteen minutes ago. The thing is probably in the air now, heading out into space, where it will drop on us with a speed almost that of light. The only warning of its coming we will have will be a flash. If we could see it in time, we could blast it with our Z-guns. But we won't have time to train a gun before it is on us. Our only hope is you. The only hope of the race is you. Have you finished that new weapon yet?"

Thielpan had moved a chair in front of the switchboard. Immediately in front of him was a cuplike depression in which rested a glass bowl, a bowl that was nearly a perfect vacuum. On this glass bowl was focused all the power of the generator. Marto did not clearly understand the operation of the device beyond this point. He knew what the equations said, but he refused to believe the math involved—refused, because to believe was to admit too much of the impossible.

"Gentlemen, we are ready," Thielpan answered. "Marto, give me that headset."

Grath saw him as he stepped forward. There was a look of incredulous repugnance on his face.

Thielpan adjusted the headset so that one metal disk was against his forehead and the other was pressed firmly against the base of his head. He plugged it in, threw the master switches. A screaming whine lifted up the scale, went beyond hearing, was present as a whipsaw vibration in their brains.

A blue glow flamed in the glass bowl, changed to purple, swirled wildly, coalesced into a pin point of light. It swelled to the size of a marble, to an egg, and now it was as big as a grapefruit. It stopped there.

Thielpan looked at the officers. "Gentlemen"—his voice was barely a whisper—"that blue globe is a force field. It exists as pure energy. All the power of our generators is draining into it. If the energy gathered in that ball were released, it would blow this city out of the Earth."

Grath fidgeted. "That is very well. But how can this be used as a weapon? We need more than that to destroy the Zarlee torpedo."

"Watch," Thielpan answered.

He closed his eyes. Marto could see from the concentration showing on his face that he was making a mighty mental effort.

LIKE a light that is turned off, the blue ball vanished. Instantly, there was in the room a tremendous, throbbing, pulsating feeling of power. Somewhere invisible in the lead-lined chamber was leashed a mighty force.

There was a click. The ball floated a foot from the ceiling.

"Lord!" an officer gasped.

Thielpan opened his eyes.

"You're almost right," he answered. "Six centuries ago the mathematicians wondered if creation were not an act of thought. They were right, as far as they went. But they lacked the apparatus to go further. This headset I am wearing gathers the tiny thought currents from my mind, impresses them on this machine. That force field builds up in accordance with my will. I can control it. I can move it where I desire. I can force it through any wall by forcing it out of this dimension, through a higher dimension and back again. That is how I got it out of the glass bowl, where it was generated. That is why it vanished, and came back. Nothing can stop it, except a similar and equally powerful force field. I can release its tremendous destructive power at will."

His voice had risen to a high-pitched scream. He stopped, and the only sound in the room was the labored breathing of many men.

"How can you direct it?" Grath whispered.

"It is extremely sensitive to all vibrations. Light and sound and a thousand other frequencies are picked up and transmitted back to me. Wherever that sphere is, I am. I can see all it sees, hear all it hears.

"And now get out," Thielpan gasped. "All but Marto. Your chaotic thinking interferes with my control. Get out."

There was a patter of feet outside and an excited orderly rushed in. He saluted Grath.

"Patrol Ship No. 81 reports the Zarlee torpedo is out of the atmosphere and is rising. It is only a matter of minutes, sir."

Grath whirled to Thielpan. "Destroy that torpedo."

Thielpan tried to rise out of his chair. His body was jerking oddly. Marto stepped to his side.

"That torpedo will be destroyed," Thielpan gasped. "Now get out."

He collapsed in his chair. His eyes were turned up, his lips blue and trembling.

"Sorry," he whispered. "I guess I'm done. There's a blood clot on my brain. Only a minute left. Marto—you take over."

IN THE split second that followed Marto plumbed deeper depths than he knew existed in his soul. It had fallen to him, this job—to him of all people. To the least among men had fallen the task of stopping the Zarlee. No one else understood the operation of the generator; no one else would serve. And only minutes remained until the Zarlee torpedo raced down.

In Thielpan's glazing eyes was a plea. The man was dying.

"I'll carry on," said Iar Marto huskily. A soft smile wreathed the face of his chief.

"Good boy."

Marto snatched the headset from Thielpan, rasped an order at Grath.

"Carry him out. And get out, all of you."

"You, of all people," Grath murmured. "No, you don't. I'm in command here, and I'll handle that headset myself. We can't risk this chance on you."

Marto, in that final moment, was calm.

"You heard his order," he answered. "Get out or I'll throw you out."

Colonel Grath paused a long second, the stub of his left arm hanging indecisively in the air. His eyes seemed to plumb Marto to the bottom of his soul. He turned on his heel. "Outside, men," he ordered.

As the massive, lead-lined door closed, Marto clamped the headset in place. That sensation overwhelmed him. As he closed his eyes, he looked out on a new world, the world as seen through the infinitely sensitive force sphere. He could see himself sitting there in the chair, his eyes closed, a haunted, panic-stricken expression on his face. A tremendous range of colors was opened to him. The dull-gray walls of lead were an indescribable hue. The unaided eye saw them as gray; the force field saw them glowing with color. There were sounds he had never heard before. The drone of the generator, that had gone out of hearing, was audible again, as a thin hiss. He felt the jar of cosmic rays striking the field like needles of fire that penetrated his mind.

But time was fleeing.

Marto did not clearly understand the control of the field. He knew he had to get it out of the lead-lined chamber, out of the city of Snarth, into the air overhead. He knew there was a way, but he did not know the way.

He willed the blue sphere of radiant force out of the chamber. Nothing happened. Sweat started to pop out on his face. There was a way! He had to find it. Desperately, he ran over the equations. The sphere shifted, flickered, changed. The secret lay in mathematical manipulation. He forced himself to think of the symbols theoretically governing the transition into the fourth dimension.

Blackness deeper than the darkest night struck his mind. He gasped for breath, forgot to think, and saw a new world. He seemed to be floating high over the Rockies. Down below him he recognized the guarded entrance to the subterranean city of Snarth.

A new vibration was ringing in his mind. It was coming from out in space, growing in intensity, and climbing up the scale. He knew, without knowing how he knew it, that it was the Zarlee torpedo. Like a ray of light, he hurled the space field out. Something was flashing downward, gaining speed as it fell—something huge and black.

He attached the field to the object, manipulated the equations of the higher dimension. Instantly, he seemed to be

inside, as the sphere shifted through a higher dimension and entered the Zarlee torpedo.

He released the prisoned energy of the field.

TO IAR MARTO, in the lead-lined chamber, it seemed that a red-hot ball of flame had burst within his brain. Stunning waves of radiation tore his mind apart. A little of him died.

To the men anxiously watching the sky at the gate of Snarth, it seemed that the blue vault of heaven had exploded. Out in space, where but a moment before had been nothing, was a vast puff of smoke riding huge streamers of yellow flame, as the Zarlee explosives were ignited by the energy loosed by the force field.

A great cry went up from the watchers—a cry that echoed and reëchoed through the levels below—a cry that was heard everywhere except in the vault where Iar Marto, regaining his stunned and weakened senses, willed into existence within the glass bowl another sphere of purple fire. Seconds later it was the size of a grapefruit. Long before a minute had passed, it was hurled out of the depths, to find a resting place in the heart of a Zarlee ship rising to investigate the failure of their torpedo. There was a smaller jet of smoke, as the Zarlee space liner burst. In the brain of Iar Marto another red-hot ball of fire exploded. A little of him died.

The visaplates of Earth throbbed with the news. Out of their hidden caverns came the rocket ships of Earth. Every vessel that could mount a Z-gun took to the air. There was at hand a little matter of vengeance. There was the trifling job of exterminating the species that had decimated Earth.

But ahead of the rocket ships, and faster than they could fly, went destruction invisible. Zarlee ships seemed to explode faster than they could be lifted from the ground. Their base, located in what had been the heart of the United States, the heart of their central headquarters, where the four-legged vermin swarmed by thousands, where their generating equipment was located, exploded in a blaze of fire that ripped Mother Earth of her molten core. A volcano spouted there.

In the mind of Iar Marto another volcano spouted.

The rocket ships caught the Zarlee as they rose in disorganized confusion and tore at them like angry dogs. Ahead of the rocket ships went destruction invisible.

Within an hour there were no more Zarlee ships. Rocket ships were landing and disgorging crews in the shattered bases, to handle a job that the Earthman found to their liking.

Over the Earth the visaplates were clamoring for the man who had delivered them. Colonel Jan Grath removed the bar from the door of the lead-lined vault.

The visaplates of the world were tuned to this door. Out of it would come the man who had saved the few remaining millions from destruction. They waited breathlessly, these grateful millions, to honor their savior.

Colonel Jan Grath would be the first to receive him. As ranking officer, it was his duty to greet Iar. Even though he knew him as a weakling and a coward, it would be his duty to hail him as deliverer. And Jan Grath would do his duty.

THE DOOR moved on its hinges. The peoples of the world held their breath. It opened an inch, six inches, a foot, and a tumultuous roar of welcome droned from the visaplate.

As Iar stepped to the door, the roar abated, stopped. There was a hiss from the speaker as the millions caught their breath in surprise.

Shriveled, emaciated, thin and gaunt,

as if he had aged a hundred years in that hour in the chamber, Iar stood, trembling, swaying, clutching at the steel door for support. Jan sprang forward to offer him an arm. As he waved the officer back, Iar noticed again that the left sleeve was empty.

"Iar! You're hurt!"

Marto managed to smile. "A little. Are—are the Zarlee finished?"

"Like smoke before the wind, They never knew what hit them. The reports are all in. There's not a Zarlee ship anywhere in the air over Earth. Their bases are shambles. Here and there the few survivors are being mopped up."

Iar winced. Jan Grath, perhaps better than any other, knew what this destruction had cost Iar. And yet Jan did not know everything.

"I am glad. Mother Earth is free again, free to go on and on to whatever is her final destiny."

"And the credit is yours, Iar. With you to lead us, we will go on."

"I! I'm sorry, but I can't lead you. I haven't the ability, in the first place, and in the second place——" He paused, a thin froth of blood coloring his lips. He wiped his lips and stared dully at the thin, scarlet streak staining the back of his hand.

Jan slipped an arm around the frail figure. Iar pushed the arm away.

"No. I have but a few minutes left and I want to stand alone as these final seconds tick away."

"But, man, let me help you!" Grath shouted at an orderly for a doctor.

Iar shook his head. "I am beyond help. You see, the force field was thought-created. I built it up through mental action, feeding and controlling the disruptive powers through mental effort. The human mind is not strong enough to stand any such current flow for more than a very short time. Only a thin fragment of my mind is left, and my body, too, is gone."

Jan stepped back. There was a question he wanted to ask, but he seemed to take hours in wording it.

"Did you know this would happen?"

Iar smiled. "Yes. I knew I would never come out of this chamber. Beta diminishes to nothing, you see——"

There was silence.

Something was happening to Jan's face. It was creasing into a thousand wrinkles; knots were bulging at the jaws; the eyes were misty. Instinctively, he knew what to do. His heels clicked together; his lean, lithe body straightened to attention; his right hand snapped into a salute—the salute of a soldier to his superior officer, the highest military courtesy.

Both understood.

Slowly, ever so slowly, as Grath stood at attention, Iar crumpled to the floor.

Interplanetary

Article No. 14 in a study of the Solar System

by John W. Campbell, Jr.

IT'S TRUE ENOUGH that a space ship can coast forever in empty, frictionless space, without expending an ounce of fuel. But it *cannot* coast up a hill two billion, seven hundred and eighty million miles high, fighting the ceaseless, tireless drag of solar gravity. Somewhere out in space, at the top of that inconceivable climb, lies Neptune. The discovery of that planet, by brilliant, mathematical research, was of immense importance to the science of astronomy, as was the subsequent discovery of Pluto. But in the interplanetary civilization we believe is to come, what practical worth, measured in dollars and economic sense, will these outposts offer? Or, in the same bitter terms, what value will the other nearer planets of the solar system have?

Once before in history a new world was discovered. That discovery is usually reported to us as the triumph of a great idea, the ultimate proof of long studies, and a wonderful, romantic voyage to the other side of the unknown. To Columbus it wasn't. To Ferdinand and Isabella it wasn't. Neither of the interested parties was fighting for the greater glory of human knowledge. Isabella put up hard cash money (gained by the economic process of borrowing on personal property, and the payment of interest) in a gamble for success—and that didn't mean successful proving of an idea. It meant bringing home the economically valuable goods of the Indies: spices and gold.

And Columbus went for expenses and ten per cent of the profits, as guaranteed by contract. Because he failed to find the Indies, he died a badly cheated man.

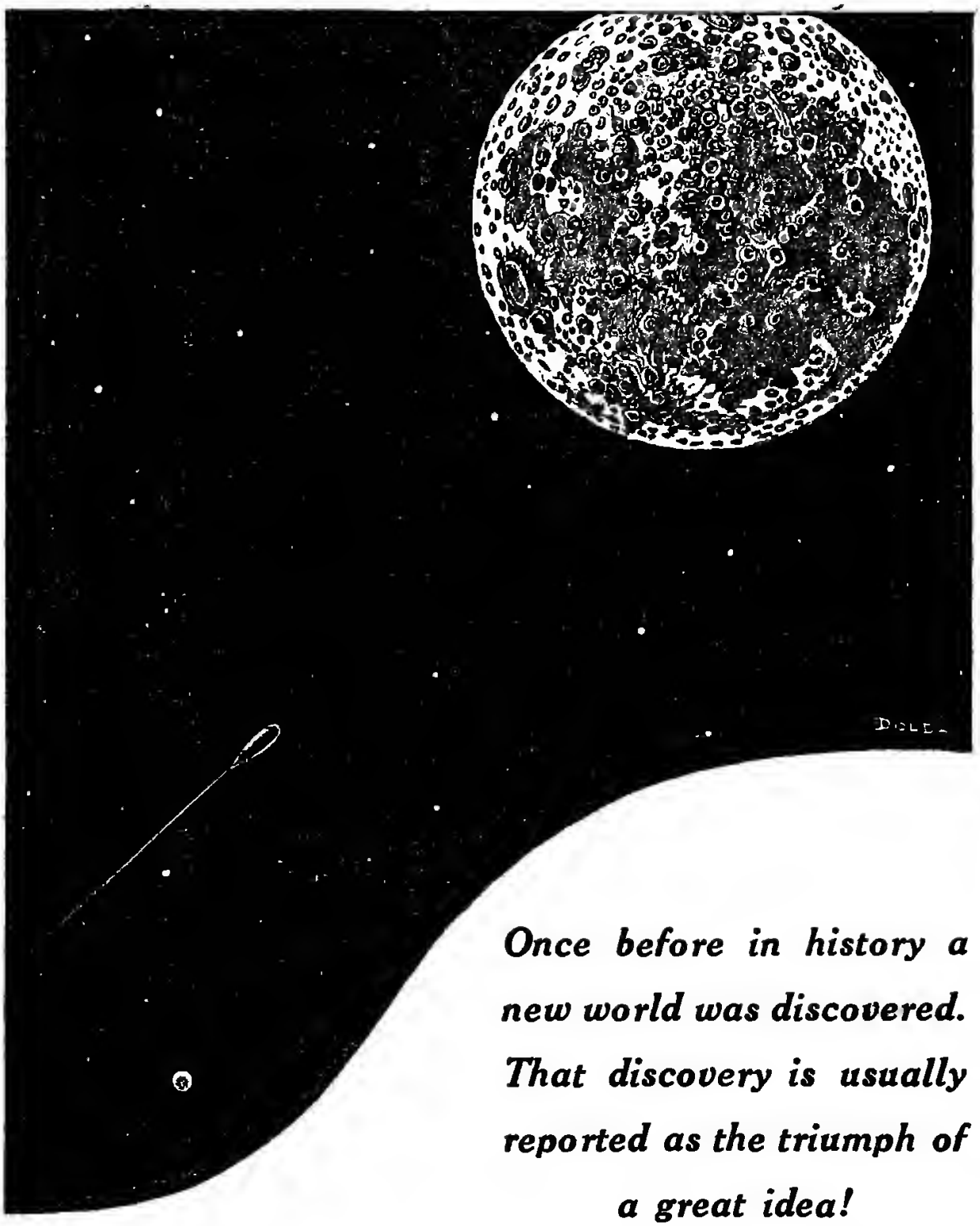
Our times are a little different, though not much, fundamentally. To-day, scientific work for the sake of knowledge can find backers, men who will give the money needed. Byrd's antarctic expeditions were financed by philanthropy. But before any one would contribute, even for this definitely, conclusively non-dividend-paying expedition, some sound benefit interpretable into terms of economic good, had to be shown.

Some day, in the not-at-all-remote future, philanthropists are going to be asked to contribute to the first expedition to the Moon. The first question they will ask will be, "Why do it?" and "What good will it do in a practical, economic way?" Pure glory does not pay, and has no sense. A man might contribute for "glory" in the financially sound form of advertising, but that is the nearest thing to a pure idea value that will bring backing.

Commercial life alone permits human life to continue. No one lives in Antarctica, but let some man find there a commercially profitable deposit of some sort, and human life can then and only then become permanent. Before Luna or Mars can become a stable, settled colony of Earth, there must be products of those worlds for sale in the unromantic streets of New York at lower prices than the competing items originating in Newark, N. J., and Chicago, Ill.

When commercial colonization of the

Dividends



Once before in history a new world was discovered. That discovery is usually reported as the triumph of a great idea!

planets does come it will spread out from Earth in widening ripples—first Luna, then Mars, then Venus and perhaps Mercury. Some of the basic rules of this quickening expansion can be laid down now, though the full story will not be known for centuries to come, long after the worlds are colonized, just

as the United States did not reach its present stature till long after 1492.

BEFORE any commercial exploitation of other worlds can take place, the ship must come. That is not too distant now, atomic-powered though it must be. Already, in laboratories, the first small increments of atomic power are being released and put to work. But one vital question seems fairly settled: atomic fuels will be cheap. Present work has shown that atomic power can be released safely, and under control, from sand, limestone, or iron, under the influence of duetrons from "heavy hydrogen."

Since one part in some 3,000 of ordinary water contains the heavy-hydrogen atom, the seas of Earth constitute an inexhaustible supply of one of the needed substances, and probably the same ratio holds over all the planets. Silicon is one of the most common of universal elements; it is the silicon of sand that reacts to yield energy.

The fuel that must power the ship is cheap. The engines applying that energy will not be cheap, nor will they last forever. The ship built around them will be enormously costly and comparatively short-lived. Some means of defense against meteors must be assumed before we begin to consider the economics of interplanetary dividends. The ship will cost somewhere up in seven figures; probably between one and ten millions of dollars for a commercial, practicable machine. Oh, the first one will be smaller, but not enormously cheaper, because those early ships, while containing less material, will carry the heavy financial load of developmental work.

The cargo-passenger ship, ready to take off for the exploitation of Lunar mines, then, will represent something like five millions of dollars as a minimum. The insurance premiums will eat enormous sums. The interest on that investment, and the additional investment on landing facilities, repair shops, business offices and so forth are all waiting for their share in any earnings the ship can bring in.

Finally—the crew, the pilots and engineers. They must be men of absolutely dependable judgment, wide experience, technically trained to the ultimate degree, a strange crossing of airplane pilot, astronomer and atomic technician. Their salaries will be *high*.

And higher than you would think today; perhaps the equivalent of $100,000 a year, for this atomic power that makes possible the ship has done other things in the world markets. It has made machine power cheap, and the cheaper mechanical power becomes, the more expensive is human labor. The human beings, remember, must purchase and consume the enormous output of the cheap, nonconsuming machine producers.

On the Moon, what type of cargo will await the ship? First, we don't know the Moon's minerals, of course, but we can make provisional considerations. Imagine that, miraculously, there exists there a mineral deposit favored by the gods indeed. In this strange deposit exist neatly stacked and sorted bars of metal, already refined and waiting merely the process of throwing them in the ship. Now, under those insanely favorable conditions, what could be brought to Earth to sell in competition with those products of Newark and Chicago and Pittsburgh?

Pittsburgh wins, hands down. Even native, metallic iron on the Moon could not compete with Pittsburgh's refineries. Pittsburgh is powered by bursting atoms, too. That makes iron far cheaper than ever before, and the cost of the ship, its insurance brokers, its mortgages and financing charges and its crew prevent dividends on even pure, metallic iron.

BUT COPPER? Silver? Lead? They might pay. Our stacked bars

would, of course; that served merely to show the first difficulty Lunar Transport, Inc., intended for profit, would meet. Before practical silver, copper, or lead deposits can be worked, they must be found. That is going to be expensive, and prospecting is going to be devilishly difficult. Not until a number of profitable mines have been opened can the individual "desert-rat" type take up the work, and those first mines must be found by organized, expensive expeditions.

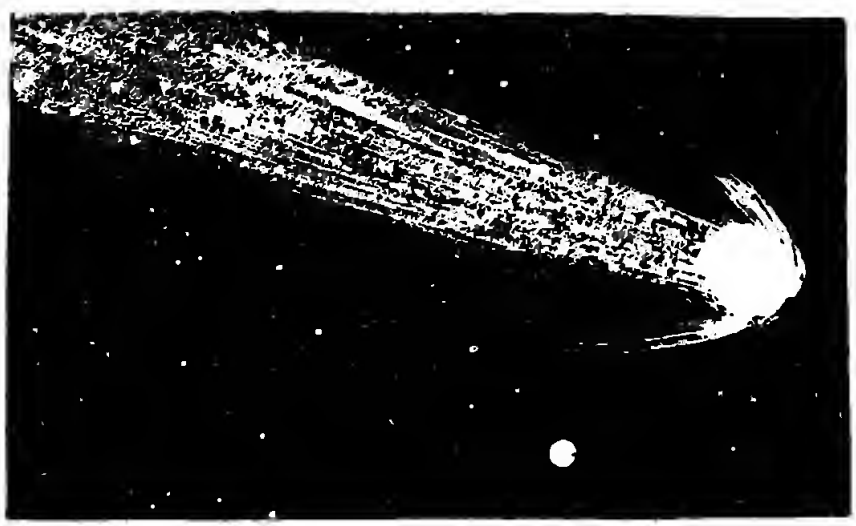
The mines, when found, must pay not only the cost of operating the ship, but also for the work of those prospectors. The copper, say, (which is to sell as cheaply as the metal produced in Arizona) must be mined by high-priced miners, operating under unfamiliar circumstances on a world other than Earth, which they will not like. The copper must compete with metal mined in a natural atmosphere (instead of under domes) where oxygen is in costless abundance for the roasting process that changes the common sulphide ore to copper oxide and sulphur dioxide. Flotation processes for concentrating the ore mined won't work, because Lunar gravity is too low.

Evidently, if we are going to mine ore on Luna, it must be a mighty rich ore, or else the ore of a mighty expensive element—say iodine for a non-metal or silver, platinum or iridium for metals.

But Luna has some advantages as an extraterrestrial source. It is very near; the trip would require only twenty-four hours or so. The loaded ship would go from a light world to a heavy, where air-friction would ease the machine to a halt, saving fuel and wear on those costly engines. The high-salaried pilots and engineers would make a round trip in seventy-two hours, and would never be long away from home. Therefore, their wages would not be quite so costly. Better yet, the ship, which is forever eating its head off in insurance, finance charges and depreciation, can make hundreds of trips each year, spreading the costs over a great many cargoes.

Beyond the Moon lies Mars. The Moon is the natural stepping-stone; it is far easier to go from Luna to Mars than from Earth to Luna, so far as the stresses and strains go. But the stresses and strains of finances meet different problems here, some eased and some made more difficult.

Transport has become a terrific problem, because the length of the journey means, even at the best of times, a longer time in transit, and hence fewer trips per year. Insurance cost and financing are on a yearly basis and, therefore, greater burdens on each cargo. Depreciation is greater per



cargo, not only because of the greater time consumed, but because the rocket engines must force the ship against the drag, first of Earth, then for at least 50,000,000 miles against solar gravity. Finally, very few trips could be made in a year, due to the short period of favorable position, and the tremendously increased cost of the long journey across Earth's orbit and out to Mars when that planet is on the far side of the Sun. Thus, a ship could not pay if used only for Martian traffic; work must be found for it during the idle period when Mars is too distant. Venus and Mercury offer possibilities here.

But Mars offers certain offsetting advantages; first, the refining of ores is far simpler, since there is sufficient atmosphere, sufficient oxygen, for this purpose. Mars' air probably contains considerable ozone, so that copper or lead ores could be converted to oxides merely by allowing them to lie crushed in the open air. Atomic power makes the reduction to the metal cheap.

Prospecting is much easier here, also, for an atomic-powered car could traverse great areas, and the men could breathe compressed Martian air. Food supplies could be planted on Mars, under domes made of glass (from Martian sand) and metal (from Martian ores). Technique now developed on Earth would permit an entire city to be fed from a few acres of potted plants, growing in water solutions of nutrient chemicals.

On Mars, lower-grade ore could be successfully worked. Further, since a large community could mantain itself on purely Martian supplies, a domestic market could develop wherein Martian goods would not compete with Terrestrian items. So far as supplying Earth with new forms of plant life goes, a peculiar situation arises. America gave Europe cotton, the potato, many other forms of plants. Mars might well supply yet other forms, but they would not grow on Earth normally, due to the vastly different conditions. However, the same technique of domes that makes Earth life possible on Mars, would acclimate the Martian vegetation to Earth, and more cheaply than space ships could import the products.

MUCH the same considerations apply to Venus, save that while all of Mars is more or less habitable for man, Venus would be bearable only at the poles. Cooling is possible, but fearfully expensive. It requires elaborate and massive mechanisms, for although atomic power makes heating easy, cooling remains a hard nut to crack. Venus, then, would be hard to prospect, except in the very limited region of the poles. Further, while shipment of metal from Mars to Earth involve carrying the load from a light to a heavy world, in the direction of the solar pull, the Venus run would make the heavy load on the Earthward trip from a heavy world, against the Sun's gravity. Greater use of rockets would bring about more rapid deterioration.

Mercury is in an even less favorable position, for solar gravity at the range of 40,000,000 miles is a deadly force. Further, only half the world could possibly be inhabited, even by miners in sheltered domes. Prospecting would be inordinately expensive and difficult, while space men would hate the blasting heat of the run so near the Sun.

However, these two inner worlds might be developed partly, to pay for the development of Mars, since ships unable, because of the planetary position, to make the Mars run could, at times, make the Venus or Mercury trip. The colonization of Mercury, however, is a long, long way in the future; insurance companies will not like executives who order ships so near the heat and attraction of the Sun.

Beyond Mars, the giant planets lie, in immense steps up against the drag-

ging solar attraction. The planets themselves cannot be visited, nor developed, because of the stupendous atmospheric pressures. The moons, however, can be visited, and will be, for purely scientific purposes. Their commercialization is doubtful, however, since all the large and commercially attractive satellites lie deep in the gravitational fields of the gigantic Jupiter or Saturn.

Meteoric material would constitute a menace, even with deflector screens, in the neighborhood of any such cosmic vacuum sweeper as Jupiter's gravitational field. Stray rocks falling toward the Sun at 20 miles a second would be deflected toward Jupiter, to form a perfect screaming hail of death. Saturn, further, has its rings which do not simply stop at a predetermined level; they probably wander vaguely, and treacherously, another 100,000 miles or so into space.

Those satellites will not even be prospected for perhaps centuries after the development of Mars. Enormously costly and elaborate expeditions would be required. There will be no one-man space ships, or even ten-man ships capable of these billion-mile climbs for long years to come.

Space ships, for centuries hence, will be in a cost class with the steam yachts of to-day. Even comparatively small ones will strain a millionaire's purse for operating expenses, and millionaires generally have more entertaining and lucrative things to do.

COLONIZATION will pass by the uniquely huge Jupiter, the uniquely ringed Saturn, and Uranus of the unique and savage climate. And Neptune, last of the true, giant planets? Neptune has even less to offer. It is a frozen, desolate waste of howling, white wilderness, terrifically cold, surrounded by a deep, frozen atmosphere consisting almost exclusively of hydrogen and helium, with faint traces of methane. Since practically all other things are frozen out, the methane bands in Neptune's spectrum are very prominent; they, in fact, give it the sea-green color that lead to its being named for the old sea god. But at the temperature of this planet, methane is a solid, the feeble concentrations of the gas in the atmosphere being only the amount in equilibrium with the solid phase at a temperature near –220° C.

Perhaps, though, an expedition could reach the surface of Neptune, alone of the giant planets. It would require a ship specially braced for strength, even then, if such a ship could climb so far against solar gravity. The very cold has frozen out most of the atmosphere. But, if an expedition did reach the surface, it would find nothing but an endless, wind-swept plain of drifting white, illuminated fitfully by a tiny, distant sun in a black sky. A dim ghost of a moon would float across the heavens.

To an Earthman, the Neptunian landscape might seem like some far vision of a future time on Earth, when the Sun was dying to a contracted, white, dwarf Sun—a tiny, glowing coal, low on the horizon, heatless almost, shedding a light sufficient for sight, but little more. To a distant horizon, the white plain of frozen gases stretches out, under a keening, screaming wind of utter cold. The white halo of an almost-familiar moon, looking very like our own, swings slowly across the sky. The surface gravity even seems familiar, for though Neptune is 17.16 times as massive as Earth, the 31,000-mile diameter weakens the gravity at the surface so that it nearly equals Earth's.

Though one of the greatest of the solar system, that dim moon remains officially unnamed, though Triton has been suggested. Only two of Jupiter's greatest satellites exceed it in size, and Saturn's 2,600-mile Titan is barely its equal. Only this one huge satellite is known to circle Neptune; but from the

frozen surface of the planet others would, in all probability, be visible. Satellites too faint to be seen, in even our greatest telescopes, must surely circle that bleak planet.

But the expedition would find nothing on Neptune worthy of effort. Only the hundreds, probably thousands, of miles of thick blanket of frozen methane, covering every mineral or deposit of conceivable value. That giant moon might offer something: bare rocks covered with a white rind of frozen gases. But there would not be any great dividends in exploiting that distant world's mineral.

Of Pluto, yet more distant from the Sun, we know very, very little. But this much is certain: Pluto is not a major planet. It is small, probably not more than 5,000 miles in diameter, and its mass is comparable with that of Earth. But—and herein lies its value—it is the most bitterly, frigidly cold of all the worlds of the solar system. It is, indeed, the ultimate outpost of the system. But, curiously, Pluto may one day be one of the most important members of the economic system within the solar system! Mercury, Venus, Luna and Mars will be exploited eventually, perhaps, and then no world will be colonized till bleak Pluto, most distant and harshest of the planets is reached.

PLUTO is cold. The temperature probably runs near –230° C. Now, ordinary cold is no asset, but such super-extraordinary cold becomes a positive, real virtue, and, for that fearful climate, Pluto may become important. This is a small planet, and as such is unburied by the immense atmosphere of a typical giant world. Here alone of the outer planets, a rocky, mineralized surface is attainable, for Pluto must have lost its hydrogen, its light gases, in the same vast proportions that Earth and the other small worlds did in that time when they cooled from the heat of creation.

Frozen on the surface rocks, must lie vast glaciers of water ice and solid carbon dioxide, perhaps a little free oxygen rendered utterly inactive by the paralyzing cold. The planet will have seas in deep valleys and vast basins, seas that froze long ages ago when the planet cooled. The last snows fell then, and welded to form glaciers that moved slowly down the valleys for a brief time, eroding the rocks for the last time before they, too, froze forever.

Since that day—a time before the first protozoan life stirred on Earth—Pluto has been locked motionless. No sweeping plain of white here, but the black, jagged teeth of cragged mountains thrusting through thin white veils. The rocks and minerals of a brand-new world, uneroded in its cold storage since the day of creation, await the exploration of geologists, or perhaps one should say Plutologists, and the exploitation of the miner.

But, most important of all, there will be a faint, thin trace of an atmosphere of hydrogen and helium, with traces of the rare, inert gases—the only things not entirely frozen on that utterly frigid world. These gases—that atmosphere of indescribably cold matter—are Pluto's richest store. It is a vast, inexhaustible absorber of heat, with all the vast, cold mass of Pluto as a reserve to draw on.

On Pluto, chemical plants will be established, plants taking advantage of impossible reactions, things that cannot happen on Earth. Atomic power will permit the warming of human habitations, but in the chemical plants reactions will take place within a few degrees of the absolute zero. On Earth the production of these low temperatures, say 1° absolute, is a tremendously difficult and costly proposition.* Experiments at these temperatures have seldom been attempted. But here, the production of those lows will be a sim-

* See the accompanying letter in Science Discussions.

ple matter, where direct cooling fins can throw off unlimited quantities of heat to a whole atmosphere, the rocks of a whole planet at –230° C.

What type of chemical operation could pay for that immense journey of 3,000,000,000 miles against the Sun's gravity? In the first place, remember that by the time a ship has passed the orbit of Saturn, the hill is leveling off, still climbing true enough, but at 1,000,000,000 miles even solar gravity is loosing its grip.

True, the journey would take years for the round trip. Costs would be high, enormously so. But—suppose the product carried on that return trip, the result of that years-long stubborn battle with solar gravity weighed only 5 or 10 pounds? 5 or 10 pounds, perhaps, of some glandular extract, synthesized under conditions that make impossible oxidation reactions easy, unheard-of condensation processes normal. Where metallic sodium is an inert substance from which reaction chambers may be constructed, if desired!

Those chemical plants wouldn't be making hundred-ton lots of sulphuric acid, or carload shipments of calcium acetate. They would specialize in the production of the finest of fine chemicals: hormones such as those that can cure a hæmophiliac almost miraculously, or plant hormones that can stimulate growth to a monstrous degree, when present in such dilution that only the infinitely sensitive life chemistry of the plants themselves can detect its presence.

One pound of such stuff might sell for a million, five million dollars, yet be an economic, wealth-producing factor of economic civilization. Divided among half a billion purchasers, it would still be a potent, valuable substance, the stuff that living animals produce in billionth-gram lots.

Or the laboratories there on ultracold Pluto might at last produce the strange molecules that, on Earth, are so sensitive and strangely unstable that they are known as life. The secret, sensitive proteins that make and are life could exist as stable molecules in laboratories chilled far, far below the temperature of liquid air.

To dissolve tissue for toxicological examination, the chemist uses concentrated nitric and sulphuric acid, and requires twenty-four hours. The dog's stomach employs no such vicious reagents, and accomplishes the solution, not by mere destruction, in two hours. Man is handicapped by the very power of his tools. At those temperatures, where his too-clumsy reagents are stilled down to workable agents, reactions differ.

Perhaps, in days to come, Pluto, the ultrafrozen world, will be the new incubator of life—synthetic life.

STERILE PLANET

by NAT SCHACHNER

THE DEEPS were alive with movement. Vague shapes shifted stealthily through the water-scoured gorges, climbed with feral certainty up the Continental shelf. The sun had long since set over the dun plateau of the interminable desert beyond, but the oasis of New York, set on its eerie perch, glowed in the darkness like a jewel of many colors.

Inclosed within its gigantic bubble of force, shimmering with a thousand hues, its central tower surging upward almost to the limits of the shielding screen, its lesser structures spaced at regular intervals over the fifty-mile radius of lush, green fields and close-cultivated crops, New York slumbered peacefully, unwitting of the threat that was gathering in the Deeps.

Earth was a dying planet. Yet the year was only 4260 A. D., not, as might have been imagined, a hundred million centuries thence. The sun rode as high in the heavens as ever, resplendent in all its pristine brilliance. But it shone on scenes of unimaginable desolation. Where once dense forests had swayed to kindly breezes, where once ripe, golden grain had interspersed with the green of many grasses, where once limpid streams had tapped the snows of mountain flanks and poured their life-giving floods to limitless oceans, where once populous cities, sprawling villages and isolated farms had dotted the planet's surface with the busy hum of activity, now there was lifelessness, death, drought, the fierce aridity of sun-baked wilderness.

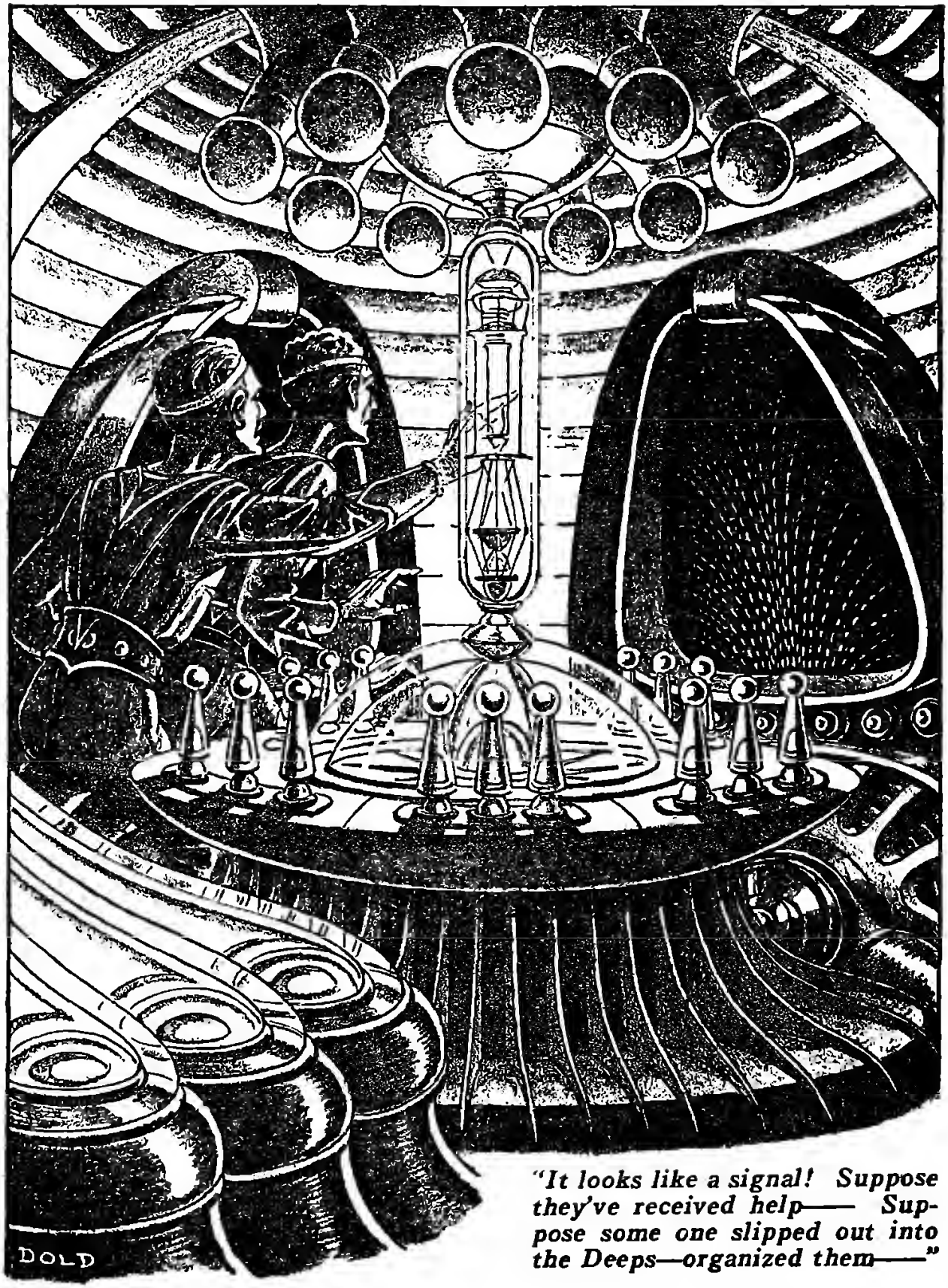
Man, the favored and latest offspring of evolution, had done this—even as had been prophesied in the early twentieth century. Deaf to all warnings, heedless of the future, he had denuded the forests, plowed up the soil, meddled recklessly with the delicate balances of nature. This, in his vanity, he had called the march of civilization; and an outraged earth struck back. As civilization marched, so did the deserts.

The matted roots of the trees, the tangled bottoms of the prairie grasses, no longer held the rain in their intertwined fingers, to soak slowly and gently into fertile loam. Instead, the falling waters ran off in quick, scouring torrents, digging huge gullies in the land, bearing countless millions of tons of crop-bearing soil into the oceans. Then drought came, and heat, and dust storms, that lifted the dried and powdered remnants to the heavens, scattered them afar, leaving naked to the parching sun the sterile sands beneath.

The process widened and deepened, even while man fought back blindly, unwilling to sink his selfish, immediate purposes in the larger, remoter good. The streams became torrents, the rivers floods that inundated, vast watersheds, scouring more and more of the fertile mulch away, dumping it into the recipient oceans, choking them, filling them up with residual silt.

Then the waters retreated, and the rains ceased. For the exposed, porous earth drank thirstily and deep of the lakes, the streams and the rivers. These sank out of sight. The falling rain made chemical combination with the elemental rawness of the underground; the oceans evaporated and were not replenished; the skies became cloudless, burning

Man—the favored and latest offspring—had done this—even as——



"It looks like a signal! Suppose they've received help—— Suppose some one slipped out into the Deeps—organized them——"

glasses to continue and hasten the process. The deserts were on the march!

MEN fell back before their resistless sweep, huddled in the remaining well-favored places, fought one another for a foothold, harried and maimed and slew for the too-scanty food. The strong drove out the weak; the cunning evicted the simple; the ruthless slaughtered the mild, and gained for themselves temporary possession of the few oases that were left on all the earth.

But they had learned their lesson. Unless drastic measures were taken, even these still fertile spots must yield to the inevitable onslaught of the deserts, must lay forever exposed to the hatred of the dispossessed. Wherefore a certain number of scientists, men of the requisite knowledge and attainments, were graciously permitted to remain and employ their talents for the common weal.

They labored well and mightily, fighting a desperate battle against time. The oases were located in places where certain peculiar underground formations, vast, cupping strata of impermeable rock, had caught and held the ancient waters and made of them tremendous reservoirs. New York, lower Westchester and adjoining Connecticut, had such a rocky basin, a thousand feet beneath. San Francisco and its hills had another; so had Capetown; a few square miles in the Crimea; the overhang of Cornwall; Lake Tahoe; the eastermost end of the Caspian—— In all, there were not over a dozen small segments of earth where man could still find the precious fluid in underground basins.

Here the scientists reared huge bubbles of force, screens of close-knit electromagnetic vibrations, shimmering with a ceaseless play of iridescence, intangible, yet more solid and repellent than the hardest rock or steel; permitting, in regulated, tempered form, the sun's light and heat to enter, but interposing an insuperable barrier to all other vibration lengths, to the coarser molecules of tangible things.

Within these shelters the scientists evolved miniature worlds of a more primitive time. The precious waters were raised to the surface by powerful pumps, spread with careful anxiety over the hoarded topsoil.

Crops were grown in the most scientific manner, from pedigreed seeds and roots, bathed in the forcing rays of ultra-violet generators. The soil's virility was renewed with alternate fields of leguminous, nitrogen-fixing plants, with fertilizers extracted directly from the atmosphere. Meat and dairy products were obtained from strictly regulated herds, pastured on the fallow, clover-bearing lands.

Air was renewed by cautious filtering through the screens, keeping within, by special absorbents, every molecule of the precious water vapor. The plants exhaled oxygen and moisture, which latter was condensed, at proper intervals, within the orbed round of the impalpable domes by ionizing discharges of frictional electricity, and dropped back to earth in gentle showers of rain. At stated periods, when the coast seemed cleared, strongly armed expeditions took off in rocket-firing planes for the vast desert regions, where iron and copper and coal and oil still discolored the otherwise featureless terrain. They mined these essential materials in frantic haste, while wary guards stood watch with death-dealing weapons.

All in all, it was a circumscribed, precarious existence. New York housed barely a hundred thousand beings, the other oases even less. All told, not a million members of earth's once teeming, magnificent civilizations were crowded into these shelters, where life could still go on and man evolve.

BUT, though the people of the oases made hasty, desperate trips into the lim-

itless deserts for the supplies they needed, there were other vast areas of earth's surface where they dared not penetrate, which they avoided with shuddering horror and the instinctive repulsion of long-imbrued tradition.

These were the Deeps!

The oceans had dried up, their waters lifted to the heavens by the burning rays of the sun, precipitated on the hungry deserts, and there absorbed beyond all recovery. But the mingled salts had remained behind, and now, as the seas retreated and laid bare their ancient, hidden beds, their tremendous concavities and sunken valleys and mountain ranges, the dried mineral salts formed dazzling coatings of bleached white, fifty to a hundred feet thick, forming a crust in which all life suffocated and died.

In the deeper reaches, however, those countersunk gorges and sinks known earlier as the Deeps, some water still lingered and festered. So thick it was with brine, so fully saturated, so remote and shaded from the absorbent sun, that no further evaporation could ensue. In these stagnant marshes coarse sea grasses grew, and certain fishes and mollusks, adapted by long centuries of slow change to such repellent quarters, moved sluggishly.

Always a miasmatic mist hovered over the surfaces of the sinks, shrouding them, hiding the struggle that went on interminably beneath. Yet the Deeps were not devoid of human kind. The hordes of the weaker, who, long eras before, had been thrust out from the ever-narrowing oases, sought shelter on the fringes of the receding seas, followed the briny waters as they shrank farther and farther into the remoter depths, found final resting place on the shores of the quiescent sinks in the very bowels of the ancient ocean beds.

There they spawned and reverted early to a primitive savagery. The coarse grasses made their cereals, the fish and mollusks their animal food. But the greatest delicacy of all was the newly evolved protoplasmic blobs of amorphous matter that put out pseudopods in the tideless sinks. Somehow, such is the inherent vitality of human kind, the population of the Deeps had grown by the year 4260 A. D. to a hundred million—a hundred million, in whose fumbling brains lingered the tradition of their ancestral expulsion from the oases, in whose savage breasts burned an ineradicable hatred for the fortunate inhabitants of those segregated Paradises, an inextinguishable longing for their possessions.

Woe to the oasis dweller who ventured from the protection of the screen, and fell into the hands of the ever-lurking denizens of the Deeps. Woe to the luckless rocket plane, winging its way high over the sunken salt beds in infrequent intercourse with the other far-flung oases, whose power failed and was compelled to seek forced landing near the mist-shrouded Deeps.

AND NOW, unknown to slumbering New York, the coastal depths were swarming with countless thousands of skulking creatures. Great, hairy, feral men they were, unkempt, shaggy, nostrils flaring with the hunt, swift of foot and nimble of step, armed with primitive weapons formed from the bones of long-wrecked vessels, with the precious freight of tumbled rocket planes.

A million wild men climbed up the steep Continental shelf and crouched in salt-incrusted valleys, panting for the signal that would precipitate them upon the looming play of colors that was their goal. For strange things had been happening in the wide-scattered Deeps. Like beasts, they had spawned and bred beyond all the primitive sources of food supply. Hunger and gaunt want stalked their ranks, drove savage bands from their lurking abodes upon the hitherto

tabooed areas sacred to other tribes. Internecine war flared and died and flared again. The precious food supplies were ravaged and destroyed. Famine devoured its own.

Then a miracle occurred: a god appeared, or so he seemed to the awe-struck millions. And with him came a subsidiary god. Out of the most sacred of the Deeps of old Atlantic—the Nares Deep, north of ancient Porto Rico, and descending to the incredible depth of over 27,000 feet beneath the once universal level of forgotten oceans—came the two gods, attended by a small but haughty band of attendants and warrior deities.

There had been legends about them—this secret tribe who ages before had found a home in the horrifying depths where the concentrated sun beat mercilessly upon thick, gummy air and pressures of many atmospheres. Tales of an impenetrable veil thrust over the sacred chasms, through which unwary prowlers had gone and never returned, of rumblings and tremblings that emanated from the pall and the clankings of metals on metals. A strange place, to be avoided on peril of fearsome consequences.

But now the gods had emerged. In their hands were curious weapons, similar neither to the primitive arms of the dwellers of the Deeps, nor like unto those wrested intermittently from the denizens of the oases. Their slender bodies were swathed in glittering, flexible garments and their faces hidden with terrible, godlike masks. In low, swift planes of an elder day, their messengers sped from Deep to Deep, exhorting the startled tribes in archaic language, preaching the message of revolt against the selfish masters of the oases, preaching the senselessness of communal slaughter.

The message spread like fire through stubble grass. The hungry hordes drifted stealthily by night from the farthest deeps, toiled up and down great mountain ranges, skulked by day within the shadowed gorges to avoid the scouting planes of the oasis men, gathered for the final assault on New York—a million brawny savages, driven by famine, animated by ancient injustice, led by a small, compact group that stood apart, dominated by a masked god and his subsidiary deity.

The night was dark, breathless. A faint moon gilded the sunken mountain-tops, failed to penetrate the fantastic deeper valleys. The salt ridges of the Continental shelf, pitted and scarred by a myriad gullies and holes, showed motionless and dim, disclosing no wit of the clinging hordes, alert for the ultimate signal.

The leader raised himself warily, stared at the beautiful hemisphere of tenuous fires that housed the faërie towers of New York, started to lift his arm. The slighter, slenderer figure at his side caught it with restraining fingers, pressed silver mask close to his, and whispered inaudible words.

He hesitated a moment, shook his head in denial, raised his arm again. Blue sparks flew upward into the darkness from the wand in his hand. At once, like insubstantial wraiths, the waiting hordes moved forward, wave on wave, toward the city of selfish plenty. The god had given the signal!

II.

HIGH in the topmost observatory of the central tower, Brad Cameron kept watch. He was obviously angry. His gray eyes snapped as he checked the detector screens, made certain that the power flowed evenly through the electromagnetic mesh. His jaw was good, his nose straight, his mouth as sensitive as an artist's, but the smooth rippling of flat-banded muscles beneath his garments as he walked, the set of his shoulders, belied all possibility of effeminacy. His

companion, an older, dark-visaged man, watched his irritation with a certain gloomy understanding.

"Another night wasted with this silly watching," Brad snapped, as his pacing round brought him to the screens which gave on the Deeps. Any untoward movement in those down-plunging abysses, any unusual vibration, must register on the sensitive surfaces of the plates. But they were darkly blank. "Those poor devils out there haven't the courage, the organization, to attack our defenses. Would to Heaven they had!"

Jex Bartol paled, lifted warning finger. "You're talking treason, Brad," he whispered in frightened accents. "If Doron Welles, our leader, should hear you——"

Brad's lean face hardened. "I've already told him," he answered more quietly. "We're pretty damn selfish, locking ourselves up, a limited number of aristocrats, within impenetrable walls of force, partaking of all the good things of life, while out there millions of our fellow creatures are starving and dying."

"But they're savages, worse than beasts," Jex protested in shocked accents. "Remember what they did to the passengers of the Caspian plane that fell in their clutches only last week."

"I know," Brad retorted gloomily. "Tore them to pieces and ate them raw. But whose fault is that? They're ravenous, desperate, and we made them so. Our ancestors drove them out centuries ago, to live or die—*we* didn't care which, as long as we were safe and snug with water and food."

"That's all ancient history," Jex said reasonably. "Earth's story from earliest times is but a repetition of old injustices. It can't affect the present. Talk sense, Brad. What would you have us do? Open our screens and let the hordes of the Deep in? Even if they didn't slaughter us at once, even if by some miracle they acted like human beings—which I seriously doubt—how long could the resources of all the oases take care of them? You know the answer. We'd all starve and die of thirst in a month—and that would be the end of life on this planet. Would you wish that?"

"N-no!" Brad admitted unwillingly. He recognized the force of his friend's arguments, had wrestled them out with himself in the stillnesses of the night. Yet they had not lessened the suffocating feeling of impotence he had always felt when thinking of the swarming savages who inhabited the Deeps. He could not, from earliest childhood, accustom himself to the hard, defensive mechanism of the others.

To them the Deeps men were foul degradations, monstrosities spawned by the fetid swamps of the ocean bed, creatures to be killed mercilessly on sight, beings without a spark of human intelligence or human emotion. Nor could Brad accustom himself to the smug self-satisfaction of the oases, to their contentment with a limited, circumscribed life, their awareness that the scanty supplies of water must inevitably disappear by slow evaporation, by absorption into the surrounding terrain. That—they shrugged—must take some thousands of years. Why should they—whose life span was but a hundred years—bother about the remote future? The adventurous spirit, the feeling of pity, of upward striving, that, in part, had actuated earlier civilizations, had died. And with it had died the true reason for man's existence.

YET BRAD retained this last precious instinct: thought of life as something more than a settled, prescribed path. He longed with an ineradicable longing for something more than the limited terrain of New York, or the occasional flying visits to other oases as

self-contained as his own. The illimitable vastness of the deserts, the precipitous drops of the vanished oceans, arid as they were, cruel as they must be, tugged at his errant feet with a sense of freedom, of glorious adventure.

"No," he repeated. "But there's another possibility."

"What is that?"

"To recreate life in the deserts, to bring back the oceans, to make this planet once more habitable, as we know it was in the past."

"Why should we bother?" Jex asked in some amazement. "Even if it were possible, and we know that it is not. It

Brad saw the girl; he didn't hesitate—— His body was an arcing catapult——

would mean endless toil, endless sacrifices on our part, and to what end? *We* are comfortable as we are; *we* don't need more territory, more food, more amusements than we have."

Brad looked at him sadly. "Jex Bartol," he said, "you're as bad as the rest of them—almost as bad as Doron Welles himself. Don't you understand? We might as well be dead as live the selfish, petty lives we do. Our civilization is stagnant; we've hardened in a mold." He laughed harshly. "Perhaps you are right. We're beyond all hope; it is better to let the human race die out in another thousand years or so,

In a single second the flowing wall would close—— The girl was trapped—and Doron Welles was merciless——

to let earth become a sterile orb, an empty planet revolving around a blind sun, rid at last of the disease called life. But there were moments, Jex, when I thought you understood, when I thought you might help——"

Pain showed in his friend's somber eyes. "What help could I give," he answered gloomily, "even if I were insane enough to agree? Doron has decreed that——"

Brad was swiftly at his side, his face aglow. "Blast Doron!" he cried joyfully. "I knew I could count on you."

"Are you mad?" Jex whispered feverishly. "Don't you know Doron has eyes and ears in every cranny of New York? Do you wish to be cast out into the Deeps, and left to the tender mercies of those very savages you're so much concerned about?"

"Don't get scared, old man." Brad grinned. "Long ago I made it my business to spy out all Doron's little gadgets for snooping on his most loyal and submissive compatriots." His grin widened. "It's a funny thing, but an accident happened about five minutes ago. Every one of them in the observation tower has gone strangely blank. Now listen to me. I've been working in secret for the last year—ever since Doron ordered me to stop my pernicious experiments. With your help I could——"

He stopped abruptly. His eyes widened past his friend's shoulder, fixed on the detector screen that gave on the Continental shelf. A shower of blue sparks sprayed upward over the sensitized surface, died down almost at once to unrelieved blankness.

"Hey!" Jex grunted. "What's wrong?"

But Brad had already sprung to the controls, thrust every ounce of power humming into the secondary coils. The shimmering of the outer field increased in intensity, wrapped itself round with pulsing vibrations of shattering force. It was death to stumble into their invisible path.

"I don't know," he answered finally. A puzzled frown wrinkled his forehead; his eyes were narrowed on the screen. It was still blank. "I saw something—blue sparks that flared up out there in the Deeps, died down at once. It looked like a signal."

Jex stared at the moveless plate, smiled darkly. "You must have imagined it. The detector would have picked up even the faintest vibration."

"I tell you I saw it."

Jex cast him a queer look. "Think the Deeps men are going to attack, eh? Suppose they do. Isn't that what you were hoping for only a minute ago?"

Brad shifted his feet, did not relax his intense watchfulness. "Don't rub it in. I'm sorry for the poor devils, but they wouldn't know it. I'd go with the rest of you."

"At least you're frank," Jex murmured.

But Brad wasn't listening. "Suppose," he broke in abruptly, "they have a screen, like our own, to blank all vibrations. Our detectors would be useless. Suppose even now——"

"Don't," remarked Jex reasonably, "be an ass. Your imagination is running altogether wild to-night. Those hairy, brainless beasts fashioning a screen?"

Brad turned on him fiercely. His eyes burned. "Suppose," he retorted, "they've received help. Suppose some one else from another oasis has been dreaming the dreams I dreamed. Suppose he slipped out into the Deeps, organized them——"

"Stuff and nonsense!" Jex said impatiently. "No oasis man would be a traitor to his own kind. Would you be a party to the slaughter of every one you knew, to the end of the oases?"

Brad's jaw was a hard rigidity. "Of course not," he growled. "That's why I'm giving the alarm."

His hand reached for the button that would fling a brazen clamor throughout the wide circumference of New York, that would bring the sleeping thousands tumbling out of their beds, and send the guards in swift aëro-cars to the flame guns and Dongan blasters. Within generations such an alarm had not been sounded.

"STAY YOUR HAND, Brad Cameron!"

The cold, passionless accents seemed to come out of thin air. They brought Brad and Jex whirling on the balls of their feet like pirouetting dancers.

They had not heard the smooth rolling back of the entrance panel, the catlike emergence of the speaker.

"Doron Welles!" croaked Jex.

The leader surveyed them both with unblinking eyes. He was a small man, smaller than either of them, but he held himself with an arrogant poise that gave the illusion of height. His lips were thin and set in a straight line, his nose pinched and bloodless, and he never smiled. For twenty years he had ruled New York, as his father had done before him, and his ancestors for five hundred years previous.

For the oasis people were an easy-going race, shorn of all initiative, of all the sterner qualities that had been bred out of their soft-lapped, limited environment. They submitted willingly, nay, gladly, to orders, to a shifting of responsibility. Brad Cameron was an exception, an alien sport. Even Jex, subjected for long hours to the fiery tirades of his friend, had not quite lost that fatalistic shrug.

Doron fixed Brad with his pale, expressionless eyes. "You have been ever a source of trouble, Brad Cameron," he said evenly. "First it was forbidden experiments—experiments that would, if successful, have inevitably disrupted the even tenor of our existence, have thrown us open to certain disaster. Then you set yourself up as an advocate of the degraded creatures of the Deeps; and even, to our face, dared question our authority.

"Worse still, wherever you have been of late, strange accidents have taken place—always accidents, so you assure me—whereby your activities are withdrawn from the necessary and lawful scrutiny of your leader. For some time I have pondered your case. You are a spot of contagion which may spread and do evil. Therefore——"

Brad grinned wryly. He had been expecting this for some time. But first —— "Spare your breath, Doron," he said tightly. "You may never get around to it. The Deeps men are attacking."

Doron Welles swung swiftly, yet without haste, to the banked screens. The secondary current raced through the outer shells, but the plates themselves were still quiescent.

"If you are trying to delay your sentence——" he commenced.

But even as he spoke, the detectors sprang into turbulent life. Signal after signal blazed into being, shouted ominous warnings to the three men in the room.

The first wave of attack had rolled up to the shell of force, was hammering with flaming weapons and twitching bodies against the impalpable fields.

III.

BRAD LEAPED to the alarm button, jabbed it with stiff fingers.

At once the oasis of New York burst into a jangle of great sound. In every sleeping cell, in every nook and corner, in every tower and laboratory, in the depths of the pump rooms, the long-disused alarm sent the echoes scurrying and clamoring.

The city awoke, stumbled blindly out into night, fearful, soft, unused to war and violence, trying vainly to remember

dim instructions, positions to be assumed in such an event.

Doron was a brave man, and swift in his decisions. "Get to your allotted posts at once," he said calmly. "I'll deal with you later." Then he was gone, back to his aëro-car, hastening to take command of the defenses.

Jex stared at his friend and groaned. "What will you do now?" he asked.

"Do?" Brad echoed cheerfully, swiftly buckling a flame gun to his belt. "Fight, of course." His face was transfigured; his eyes glowed. Here was balm for his restless spirit, adventure, the shock of untoward events. In a trice he had forgotten his former qualms, his brooding sense of injustice.

"I don't mean that," Jex countered impatiently. "We're safe enough against any primitive weapons the Deeps men can bring to bear. I mean Doron's sentence. He never changes a decision once made."

Brad paused in his outward flight, looked strangely at his anxious friend. "Jex," he answered soberly, "I'm afraid there's more to this assault than you think. The Deeps men never dared make a frontal attack before; they never massed the hordes that our screens indicate. Perhaps Doron will never have a chance to execute his sentence."

"You mean the Deeps men may win?" Jex demanded incredulously.

Brad did not answer. Instead, his hand went forward in an ancient gesture. They shook hands. Jex was speechless. Then Brad was gone, out of the observatory, into his parked aëro-car on the landing space outside. His last glimpse of his friend was one of open-mouthed amazement—an awkward, undramatic picture with which to feed the memory. He never saw Jex Bartol again.

At the rim of the abyss Brad found wild turmoil and confusion. The men of the oasis, roused from sleep, blind with fear, scurried wailing and helpless from post to post, wasting their flame discharges on their own wall of force, missing completely the synchronized slits that formed and reformed with scientific precision for their benefit.

The great Dongan blasters were better manned; here a trained band of guards took command, sent infernos of destruction hurtling out into the night. Brad took his station quietly, calmly, before a synchronized slit, pressed the trigger of his flame gun as fast as fingers could twitch.

There was no question about it—the Deeps were in motion. Before him stretched the transparent, multicolored thinness of the defending mesh of electromagnetic vibrations. So tenuous, so impalpable, a mere racing whirl of shimmering rainbow, that it seemed incredible it could hold more than an instant against the incalculable hordes who washed up against it in surge on surge.

Star shells sent up from the oasis burned bright day into the Deeps—a swift slant of a hundred feet from the outer rim of New York, crusted with salt; then, far out, where the old Continental shelf ended, a great drop into depths unfathomed, into the very bowels of the earth.

Yet from those dreadful depths spewed out, in ceaseless billows, an endless spawn of men, hairy, seminaked, snarling with savage hate, brandishing weapons of modern make and ancient resurrection alike. On they came, thousands, hundreds of thousands, millions!

THE great Dongan blasters caught their crowded, swarming ranks, tore wide gaps of destruction; the flame guns, in the hands of those like Brad who kept their head, spurted liquid fire on screaming, writhing bodies. But still they came, billowing, interminably inexhaustible.

Their weapons blazed futilely against the mesh of force, splashed huge blobs of flame along its curving surface; they

threw themselves in desperate madness against the thin transparency that held them from their enemies, and piled up in smoking heaps on the secondary screen that Brad had established. Yet, with a reckless bravery that Brad could only admire, they clambered up and over the dead, seeking somehow to break through by sheer weight of numbers.

And ever and anon, the synchronized slits did not close fast enough, and a thin sheath of destruction seared through screeching defenders, crisped far off buildings, to powdered ash.

Brad squinted at his weapon, found it empty, recharged its catalysts from a placement tank, sighted coolly through the slit as it opened, squeezed. Flame caught furious faces, carried them howling into char and liquefaction.

"You are doing very well, Brad Cameron," a calm voice said in his ear.

Brad flung a hasty look to one side, saw Doron Welles, slight, erect, imperturbable, thin lips compressed, carefully waiting for his breach to flash wide. Then he took aim, fired. Strapped to his chest was a tiny microphone, into which, between shots, he spoke in level accents, sending orders to all the harried fronts, receiving information from his panicky lieutenants.

"Thank you," Brad retorted with a grin. "You're not doing so bad yourself."

The leader frowned. "You need not think," he said precisely, "by disrespectful adulation to swerve me from the sentence I shall impose on you."

Brad grinned mockingly. "Far from it. Only—I don't think you'll get the chance."

Doron swung half around, weapon covering Brad. "Just what," he rasped, "do you mean by that?"

But Brad disregarded the threatening flame gun. "Look for yourself," he said soberly. "Something's happening—at Station 15."

Doron's eyes followed his gesture suspiciously. His small eyes narrowed; in one swift movement he was on his feet, racing toward the beleaguered station, purring swift orders into his microphone even as he ran. Brad was at his side, running easily. In spite of himself, he confessed a certain admiration for Doron Welles. He was a man.

"I suspected something like this from the beginning," Brad jerked out as they raced along, side by side. "I knew the Deeps men couldn't have planned such a terrific attack by themselves. They've been organized—and skillfully—by some one intellectually our equal—or superior. Their massed assault has been a blind; the real siege was concentrated on Station 15."

Station 15 was the portal through the defense screen which gave on a narrow, subterranean plain where the Rockaways had once shelved off gradually into the depths. On this plain stood a group of a hundred men or so, clad in jet-black, flexible garments, their faces hidden behind black, anonymous masks. But two of them were differently attired—in shining, glittering garments, and masks of silver splendor. One, seemingly the leader of the band, was heavy of body and broad of shoulder; the other was slight and slender and springy of carriage.

BEFORE THEM, on a rolling platform, a disk whirled around and around on a cradled axis, and, as it spun at incredible speed, a shining wall of transparent force built up in front. As the platform steadily advanced, the frontier of energy moved along until it made contact with the defending vibration mesh. There was a blinding flash of incandescent energy, a sizzling, roaring sound that blasted all the other noise of battle into quietude, a flame that leaped high into the night toward the tingling stars—and the impregnable bubble that surrounded New York sagged and pressed inward.

Already the guards who manned the Dongan blasters whirled from their weapons, fled screeching and howling toward the interior city. Already the first thin gash showed ominously black in the multihued screen.

Brad ripped out an oath, flung himself upon the nearest abandoned blaster. Without a word, Doron stationed himself at the second.

Outside, the strange invaders pushed forward in triumph, the two shining figures in the lead. The tear was getting wider. The howling Deeps men swerved from their assault, pelted madly toward Station 15. The Continental shelf was a tossing, heaving bedlam of racing savages.

"Shoot as you've never shot before," Brad shouted. "They'll be upon us in a minute."

Doron turned prim face upon the man he intended to punish. It bespoke stern disapproval. Even in the face of swift annihilation Doron Welles could not forget matters of punctilio.

But his Dongan blaster spoke, and spoke again. There was no need to wait for slits to widen and close. The rip was wide enough for ten men to plunge through abreast. Brad's mighty weapon belched forth its cargo of destruction in quick, staccato phrases. Wherever the hurtling disruption met the lunging, unprotected savages of the Deeps, it cut wide swaths of frightful death in the close-packed ranks. But it battered harmlessly at the countervailing screen, making no slightest dent in its shining surface, and diffused into flashes of impotent energy.

On and on pressed the field of force; behind it rolled the generating disk; and on and on sped the little band of masked invaders, sheltered from all harm.

Even in the face of inevitable defeat, of sudden annihilation, Doron Welles did not, by so much as a twitching muscle, reveal concern. The Dongan blaster smoked and roared and blasted away as ever.

Brad thought quickly. The breach was growing wider. In seconds now —— "Keep going, Doron!" he yelled. "Don't let up a moment." Even as he howled out his advice, he flung away from his weapon, seemed to abandon the battle in jittering flight. But he had a plan, and he wished all attention to be distracted from him.

The source of the enemy's power was the disk which built up its overwhelming shield of force. It could not be reached by frontal onslaught. But, in the swift advance, the angle of attack had shifted slightly to one side, making a thin, acute angle with the farther reaches of Station 14. There, ready at hand, on its swivel platform, rested a deserted blaster.

Crouching against observation, Brad raced for its quiescent bulk. He clawed around the edge of the platform, straightened cautiously, hidden from view. He grunted his satisfaction. It was just as he had thought. The conquering enemy screen was a thin edge toward him. By careful aiming, he could sheer along its inner veil, barely impinge upon the rotating disk.

But he must work fast. Already the line of attack was swinging in, would pivot the impenetrable screen to a wider angle. Feverishly, yet with fingers that did not tremble, he rotated the platform through a ten-degree arc, sighted his weapon, jerked all the charges in one vast explosion from the firing chamber.

The great blaster belched its multiple swath of flame; lightning bolts crashed out into the void. The gun vibrated with a cataclysmic roar, burst into a thousand pieces. Brad was flung sprawling from the platform. Bruised, battered, deafened by the mighty blast, he jerked groggily to his feet. A hoarse cry of joy rushed from his lips, stifled almost at inception.

Where were they taking him? The depth pressure grew more and more heavy—buzzed in his ears—weighed on his heart——

HIS AIM had been true. The whirling disk was no more; the mesh of interwoven energy it had set up was gone. But the men who had controlled it were leaping for the steadily narrowing breach in the defensive bubble. Soon the pulsing currents from the central power station, no longer rendered impotent by the counterbalancing screen, would flow into the gap and make it whole again; but before it could, the strange, masked figures would be inside the shield. And only Doron stood in their path.

Brad flung forward, jerking at his flame gun. On they came, black, terrible figures, led by two in shining silver. Doron pointed his blaster calmly. It roared. The stocky figure in gleaming metal seemed to shatter into a thousand shards. Behind him half the men in black whiffed out of existence.

Brad heard a shrill cry of anguish from the slighter, slenderer figure in flexible silver. For a moment it hesitated, swayed uncertainly; then it darted on again, toward the fast-closing breach. But it came on alone. For behind, the survivors in black milled inconclusively, aghast at the fall of their leader, at the terrible decimation of their ranks.

Doron Welles, with a slight sneer, reached bloodless fingers for the pressure trip again. But in that moment Brad had seen, and seeing, jerked forward with a terrible cry.

The mask had been ripped loose from the slender features, had revealed to his startled gaze the delicate lineaments—of a girl—a girl of aristocratic loveliness, with warm, blue eyes and rippling, golden hair, a girl of unbelievable grace and breeding!

Doron saw her, too, but no pity showed in his thin lips, his cold, expressionless eyes. His hand did not waver from the trip. Brad could have shot him down, did not. Instead, his body was an arcing catapult, his fist a slamming thunderbolt. It caught Doron, untouchable leader of New York, behind the ear. He fell in a heap, without a sound.

The girl was already within the breach. She did not know that she had no followers. Her eyes met Brad's. She knew he had saved her life. Instinctively, Brad acted.

In a single second the flowing wall would close behind her, beyond all opening. The girl was trapped; and Doron Welles was merciless. She had attacked his domain, and must suffer the consequences. Nor would he remit his proposed sentence on Brad. Further, Brad had knocked him down, had committed the unforgivable offense.

Brad swept forward in a single motion, caught the startled girl in his arms, smashed blindly on—just in time. He flung out into the shelving Deeps, rolled over and over down the long incline, the girl locked tight and warm in his arms, right into the huddled mass of the company in black. Behind him, the barrier of New York was irretrievably whole again.

He flung up his arm as a black mask bent over him. A shining weapon swung viciously down. The girl struggled in his grasp, cried out something. The weapon faltered. Then his whirling, tumbling body crashed into a jutting rock. Stars split the darkness. He lost consciousness.

IV.

IT WAS obviously all a dream, or worse. He had died and gone to—well, it did not matter. He had a distinct memory, in his semiconsciousness, of having been swiftly transported in a shining aëro-car of strange construction, over subterranean mountains and fathomless gorges, over tremendous fields of crusted salt, over recessive deeps, where miasmatic mists veiled incredible crawling swamps—but always down,

down, down to the uttermost bones of a skeleton planet.

Dimly, he was aware that the girl was at the controls, her hair a golden glory overtopping the silver flexibility of her garments. Near them fled other cars, piloted by men in somber black. With a sigh, he relaxed. Obviously, the attack on New York had failed, had been abandoned. He had been responsible for that.

But where were they taking him? His brain was still a fog from the shattering blow he had received. The depth pressure grew more and more heavy, buzzed in his ears, weighed on his heart. Each inward breath was a painful effort. Then, deep beneath his swimming eyes he saw a pall, a layer of dense, unrelieved black, impenetrable to the prying rays of the moon, making a tideless sea between terrific upthrusts of baneful mountains.

The car tilted even more steeply, plunged headlong into the inky shroud. The pressure grew insupportable. But before he again passed out of the picture, Brad knew where he was being taken. He had heard strange legends from captured Deeps men of this subterranean retreat of the gods, of the invisible tribe who lurked in these terrifying depths——

She was speaking to him, and her voice was like the plangent tone of waterfalls, of silver bells striking in unison. He was seated in a great, underground cavern, carefully sealed against the terrific pressure of the Nares Deep, made breathable by ingenious generation of air currents, lighted to an even daylight by glow machines operated by the flash extinction of positrons with electrons.

All about them were evidences of a vigorous, well-advanced civilization, higher even than that of the oases. To one end of the vast cavern was a lake, its black waters sullen in a rocky rim. Around it, spreading over fifty acres, nurtured by a battery of overhead heat and ultra-violet ray machines, were crops —wheat, rye, lettuce, asparagus, soy beans, corn, beets—sturdy, close-grown, luxuriant.

And everywhere machinery hummed and buzzed, machinery of complicated parts—some of them recognizable to Brad, others strange in design and function. Comfort was everywhere, luxury of a more Spartan mode than that of the oases. And everywhere the men and women of this underground world, strong of body, alert of visage, efficient in movement, tended the machines, harvested the crops, nursed the hurts of those who had been wounded in the assault on New York.

BUT BRAD'S GAZE always came back to the face of the girl before him. She had told him her name—Ellin Garde. She was more breath-takingly beautiful than he had thought, with candid eyes in which sorrow and troubled grief still held sway. Her lips trembled as she told her story; yet her voice was steady. Her words were the words of the universal language that had ruled the earth from before the great drought; yet they were queerly archaic, liquid, polysyllabic.

"We were some of those whom your ancestors drove out from the oases to die of thirst and hunger in the Deeps, Brad Cameron," she said. "We were too civilized, too philosophical, perhaps, to fight with weapons for our homes. Weston Garde, my ancestor, went with them. He was a very great scientist."

"But why?" Brad protested. "I understand the scientists were invited to remain."

She lifted her head proudly. "The Gardes were always on the side of the oppressed," she told him coldly. "It is true they asked him to stay, to build protections for them, but he refused. He

went out into exile, along with those who had been driven to a seeming certain death. At first he tried to help all of the dispersed. It soon proved impossible. There were too many; and in the ferocious struggle for a bare existence, they quickly reverted to the brute, fought and slew and drove each other from the slimy swamps that still remained.

"Sick at heart, Weston Garde gathered about him a chosen group, found this hidden cavern in the deepest part of the old Atlantic, this well of still-sweet water. Here he tried to build anew his civilization, to recreate and advance what had been his ideals on earth. To keep out the ranging tribes of savage men, he screened the entrance with a dense fog of his own contriving, skillfully scattered the legend of taboo, of godhead. Some day, he hoped, these legends might prove valuable."

A spasm of pain fled over her face. "They did; though I wish now they had never been instilled. For they have brought about the death of my brother."

Brad leaned forward remorsefully. He ached to take her in his arms, to comfort her. "He was your brother then—the figure in the silver mask?" he asked gently.

She nodded her head. Her eyes were brimming with tears, but they did not waver. "Poor Haris! It was his idea, and the memory of Weston Garde urged him on. He was an idealist. The thought of those poor, starving brutes outside kept him from sleep. The reports we received through the spies we sent out into the Deeps were horrible—of men and women and children dying by the hundreds of thousands, of food supplies, such as they were, exhausted, of cannibalism rearing its ugly head.

"And all the while you, selfishly safe within your domes of force, surfeited with food and water and all the amenities of life, paid no heed to this logical end of your ancestors' greed."

"You, also, were equally comfortable and remote from the struggle," Brad pointed out.

ELLIN flashed up at that. "How dare you compare us?" she cried. *"We* had never been guilty of the foul injustice of the oases; we, too, were in exile." Then her indignation died; she nodded her bright head pathetically.

"Poor Haris thought of that as well," she said. "It made him more restless than ever. Finally, he determined to lead the dispossessed against their former homes, to compel a redivision of what rightfully belonged to all. He convinced our comrades that he was right. He was a marvelous orator. He built and perfected his screen of thrusting force—and he sent emissaries to arouse the dwellers of the Deeps. He would have succeeded, too, if it hadn't been for—for——"

"For me, you mean," Brad completed the sentence for her. He took her hand. It lay small and unresisting in his. "I know, yet I am not sorry—even though it meant your brother's life. For, like all idealists, he did not think things out very clearly. In the first place, he could never have controlled the savage hordes in the flush of their victory. They would have butchered every man, woman and child in the oases, for the remote sins of their ancestors. In the second place, even with the strictest precautions, with the most scrupulous conservation of every bit of food, of every drop of water, of every item of machinery, it would have been impossible to provide for all the teeming millions of the Deeps.

"Now almost a million are adequately housed; let us say five million, all told, could have been taken care of. There are a hundred million more. What would happen? The strong would rise and slaughter or dispossess the weak, even as in the past, and once more the cycle would start its weary round."

She looked at him, wide-eyed, startled. "We—we hadn't thought——"

He laughed, tenderly. "Of course not! Idealists never do."

She buried her head in her hands. "Then it was a mistake from the very beginning," she whispered in a still, small voice. "My brother's death, the death of so many brave comrades, of those poor, starving savages who depended on us for guidance—it was all in vain." She lifted her head; her eyes flashed. "I hate you, Brad Cameron," she cried vehemently. "You have taken away the only comfort I had: the thought that they were martyrs in a worthy cause."

He gripped her slender shoulders, said roughly: "Hold fast to that belief, Ellin. It's a fine, heart-warming belief. And I'm not so certain that it's wrong at that."

"What do you mean?" she demanded eagerly.

"Just this. For several years I've been working on the problem. Doron Welles forbade me to proceed any further. My plan, nebulous then, might, he thought, disrupt the peaceful seclusion of his domain, precipitate the oases men into a world of struggle, of sacrifice, of incalculable hardships. You, Ellin, and your brother, were not afraid; neither am I.

"Your desperate battle to gain salvation for the degraded men of the Deeps, though it cost Haris' life, and the lives of thousands of others, did this much: it released me from my bondage to the slave instincts of my community; it brought us together to pool our resources; and it forced a measure of organization, of discipline, upon the men of the Deeps." He smiled whimsically. "That latter will prove to be most necessary."

SHE STARED at him, as if seeking to read his thoughts. The men of Nares Deep, hearing him, stopped their tasks, drew nearer to listen.

"You have a plan," she said slowly, "to—to do what?"

Brad weighed his words. "I have," he answered, "and it's nothing smaller than to rehabilitate the earth, to make it once more livable and fertile for the outlawed denizens of the Deeps."

Now he had his sensation. They dropped their work frankly, crowded around, skeptical, serious. It was incredible what this stranger promised. For a thousand years they had lived immured in this sunless cavern; for a thousand years the few oases had been walled off from the rest of the world; for more than a thousand years the earth had been a vast, lifeless tomb.

Ellin started up, fell back in despair. "I'm sorry, Brad," she whispered, "but I can't believe it."

"Yet it's simple enough," he assured her. "The principles involved are elementary; all that is required is a vast labor power, and certain scientific equipment. The first the Deeps men shall furnish us; for the second, I shall rely on your scientists for aid."

"But——"

"I'm coming to it. The earth itself is ruined beyond all hope. The topsoil is gone forever, leaving only sterile sand and rock behind. But where did this life-breeding soil depart?"

"Why, into what once were the oceans. But——"

Brad grinned. "I know what you're going to say. It's buried beneath countless tons of salt. Well, what of it? I told you I needed tremendous man power. We'll dig the salt away, transport it to the desert plateaus of earth—not all at once, but first from the level beds, where it is not more than a few feet thick. Surely we can fashion sufficient power diggers and conveyors to release ten thousand square miles of territory within a year.

"Underneath, we shall find the most

fertile, the most inexhaustible soil this planet has ever seen, even in the halcyon days of its youth. Not only does the lost topsoil of earth lie there, but also millions of years of dropped decay of plant and animal life, of dead plankton, of foraminiferous ooze.

"With this as a base, we could within the following year feed all the Deeps men on adequate rations. Meanwhile, the work will progress until all the Deeps are cleared. Actually, Ellin, since the Deeps represent about four fifths of earth's surface, there would be more habitable land than there has been since the world began."

"You forget, Brad," she protested faintly, "that there must be water before crops can be grown."

"I DIDN'T FORGET. I was coming to that as the next step in our rehabilitation program. The earth, as a matter of fact, never lost its water."

"What?" From all sides came exclamations of disbelief.

"Exactly. The water of the oceans, the streams and lakes of old, was not driven out into space; it simply sank into the arid soil and became unusable. Some part, it is true, entered into chemical combination with earth's elements, such as iron, and could only be recovered by Herculean efforts. But the most of it combined with thirsty salts and oxides and became fixed as water of crystallization. Copper sulphate and sodium carbonate are examples of such salts. But the combination is an unstable one; a mild heat will release the imprisoned water in the process known as efflorescence.

"We have the means to induct sufficient heat into the deserts abutting the Continental shelf to bring the water tumbling out of these buried salts and oxides. Place batteries of electrodes in the given areas at the desired depths, set up your disks of revolution, our solar converters, generate electromagnetic swirls of energy. The resistance of the soil between the electrodes will convert the energy into heat.

The water will filter through the loose sand, precipitate itself by ancient gullies into the Deeps. There we can channelize the precious fluid, use it for irrigation. Year by year, the area under civilization, the water supply, will grow larger and larger, until, who knows, in some future era clouds will form and rain descend; crops will grow and forests stretch interminably, even as in forgotten ages."

A great shout burst up from his listeners at the thrilling vision he had evoked. Ellin placed her slender hand on his; her eyes looked deep into his own.

"It will not be a matter of a day or a year," Brad said somewhat unsteadily. "It means all the days of our lives, and perhaps the lives of the children who shall come after us."

"*Our* children?" she repeated softly, and flushed. But she could say no more. Her further words were oddly smothered against Brad's lips. A brave new world was to be born, and they, and those who gathered around them, were harbingers of an earth remodeled. What man had destroyed in his selfishness and greed, man could restore with sacrifice and courage. The future seemed very near to them just then.

Next month Nat Schachner gives us another great science novel:

CRYSTALLIZED THOUGHT

FUSIBLE ALLOYS

A Scientific Discussion

by WILLY LEY

IT MAY sound exaggerated, but it is nevertheless true, that all our present-day technical achievements, which we are so very proud of, would have been impossible if there had been no alloys. If some subtle change in the constitution of the atoms of the metallic elements suddenly made alloying an impossibility, our civilization would suffer a severe breakdown. Almost every machine, from electric-power plants down to typewriters, and even fountain pens, would need redesigning, and it is certain that many of them could not be redesigned.

Pure metals are usually poor metals, if looked upon with the eyes of an engineer. They are either too hard or too soft, too brittle or not tough enough for technical purposes—at least it would be better if they were harder, tougher or more elastic than they really are. It is a matter of common knowledge that it is possible—by means of careful mixing, balancing and heat treatment—to obtain the wanted properties. But, if you only stop to think about it, it is somewhat miraculous to see an alloy that is very resistant against corrosion emerge from the mixture of two or more metals that have hardly any noncorrosive features at all.

The melting points of alloys present a similar phenomenon. In fact, they contradict anything that could be expected according to the rules of "common sense."

Lead, for example, if it is pure, melts at 326 degrees centigrade. Tin has a melting point of 232 degrees centigrade. A mixture of tin and lead could be expected to melt at a temperature somewhere between 232 and 326 degrees. Actually, the melting point of the mixture may be lower than that of tin. If one adds a part of lead to pure tin and measures the melting point of the alloy and repeats this procedure with 2 and 3 and 4 parts of lead, until there is only one part of tin and 99 parts of lead in the mixture, one can draw a diagram (Fig. 1) of the melting points of lead-tin alloys.

The lowest melting point of the diagram is called the "eutectic melting point" and the alloy which produces it is called the "eutectic alloy" or the "eutecticum." The eutectic melting point of lead and tin is 181 degrees centigrade, the eutecticum of these two metals is tin with 35.97 parts of lead.

This behavior of alloys was discovered very early and it was soon learned that there are also eutectic alloys of 3 or even more metals possible. The law calls alloys that melt in boiling water (i. e. below 100 degrees centigrade) "fusible alloys." The first fusible alloy was found by Valentin Rose around the middle of the sixteenth century. It is still known under the name of Rose's metal. Another very similar alloy is D'Arcet's metal, which was found soon afterward.

When, in 1817, the German Strohmeyer discovered cadmium a new era of fusible alloys began. Wood metal and Lipowitz metal were found. Wood, who produced his alloy for the first time in 1869, is said to be the father of a well-known practical joke. He cast teaspoons of his alloy and served almost boiling tea, so that his guests suddenly found themselves solemnly stirring air with only the handle of their teaspoons.

The interesting branch of metallurgy that busies itself with fusible alloys, has made much progress, due to the introduction of a few rare metals that were not available for experimentation until recently. Indium, for example, belonging to the so-called aluminium group of metals, was twice as expensive as gold only a decade ago. Then its price dropped considerably. At present its value is about halfway between that of silver and gold and it can, therefore, be used for certain industrial purposes.

The German mining gazette (*Deutsche Bergwerks Zeitung*) recently reported a fusible alloy consisting of 50 parts of bismuth, 27 parts of lead, 13 parts of tin and 10 parts of cadmium. This mixture is heated to about 350 degrees centigrade. Then a small amount (exact percentage not stated) of indium is added to it. The mixture is kept at 160 degrees centigrade for a while and cooled very slowly. The melting point of this alloy is 48 degrees centigrade.

Another new fusible alloy, reported by Dr. Sidney F. French of Colgate University, consists of lead, tin, cadmium and 18 parts of indium. The melting point of this alloy is 46.5 degrees centigrade. Dr. French also reported that one additional part of gallium lowers the melting point to 41.5 degrees centigrade. One might expect that more gallium might be useful in lowering the melting point still more. This, however, is not the case.

IT IS interesting to note that those pure metals which have low-melting points belong to almost all groups of metals. The lowest-known melting point of a metal is that of mercury (38.5 degrees centigrade below the freezing point of water). Mercury belongs to the so-called Copper Group, the other members of which have high melting points (copper 1063°, gold 1064°, silver 955°). Lead and tin constitute, together with germanium, the Lead Group, but germanium's melting point is 900 degrees centigrade.

Indium (155°), gallium (appr. 30°) and thallium (301°) belong to the Aluminium Group, the other members of which (aluminium, cerium, lanthanum, neodymium and praseodymium) have melting points between 623° (cerium) and 940° (praseodymium). Cadmium (321°) and zinc (419°) belong to the Magnesium Group to which also belong magnesium (650°) and beryllium (1278°).

The melting points of the so-called Alkali Group (potassium, sodium, rubidium, cæsium and lithium) are, with one exception (lithium 180°), lower than the boiling point of water, but their stormy chemical character renders them unsuitable for alloying. The two remaining groups of metals, the Titan Group and the Calcium Group have no members with low-melting points. Those of the Titan Group (titan, thorium and zirkonium) are around 1800 degrees centigrade; those of the other group (calcium, strontium, barium and radium) are around 800 degrees centigrade.

The alloys mentioned above are by no means the last word in Fusible Alloys. The scientists Pushin, Stepanovitch and Stajitch reported in 1932 an alloy consisting of 12 parts of tin and 88 parts of gallium, with a melting point of 15 degrees centigrade! (60 degrees Fahrenheit.) And the eutectic alloy of

indium and gallium—not yet known—is expected to have a melting point of zero degrees centigrade. This alloy would melt together with ice and become solid together with water.

Interesting as the field may be from the standpoint of pure science, the question as to the practical application is inevitable.

Up to now there were only a few practical uses for fusible alloys. During the last century solid safety plugs for boilers were made of fusible alloys, but it was soon found that these safety plugs were very unsafe. The long exposure to temperatures near the melting point decomposed the alloy so that it gradually attained a much higher melting point than it was thought to have. Then automatic sprinkler systems were devised where fusible alloys played an important part. But they were soon replaced by electrical devices.

When aviation was new and gasoline tanks of unusual shape were required, Wood's metal found a new and unusual application. The gasoline tanks specified by the U. S. army were to be of copper and seamless. After some headache the designers hit upon the idea to make the tank first of solid Wood metal. Then they copper-plated it electrically to the desired wall thickness and placed the whole tank in a tub with boiling water, so that the alloy melted out.

The new fusible alloys with indium, that have a melting point of about 42 degrees centigrate (106° Fahrenheit), have many more and much more important possible applications. In scientific and medical work they can be used almost anywhere where plaster of Paris is now in use.

It is safe to predict that plaster casts around broken limbs will be fusible-alloy casts in the near future. If the alloy is put inside flat bags it can be wrapped around the broken limb on top of the gauze. As soon as it cools off it will hold the limb immovably rigid. If the "cast" is to be removed it is only necessary to place rubber hot-water bottles, that contain the alloy, on top of the flat bags until it melts. Then the "cast" can be removed easily and painlessly and can, if necessary, be replaced equally easily. Since these bags, after disinfection, can be used over and over again, it is relatively unimportant that the price of indium is still high.

The advantages of this procedure are so obvious that it is hardly necessary to mention them. In addition to the easy application and easy and painless removal, the cleanliness is most important. Plaster of Paris happens to be a material that usually results in what can only be called a mess.

Since Wood produced his alloy, the field of fusible alloys has been lying dormant. They were hardly more than a scientific curiosity. But the introduction of indium and gallium offers so many new applications that one may expect this neglected branch of metallurgy to acquire much practical importance.

Table I.

FUSIBLE ALLOYS

Name of Alloy	Bismuth	Lead	Tin	Cadmium	Melting Point Centigrade
Newton's metal	8	5	3	—	95
Rose's metal	5	3	2	—	91.6
d'Arcet's metal	10	5	5	—	91.6
Lichtenberg's metal	5	3	2	—	91.6
Wood's metal	50	25	12½	12½	65
Lipowitz metal	50	27	13	10	65
Cliché metal	33.3	33.3	33.3	—	130

Table II.

PURE METALS OF LOW-MELTING POINT

Name:	Chem. Symbol	Atomic Weight	Melting Point	Boiling Point (I)
Mercury	Hg	200.6	38.5	357.25
Lead	Pb	207.15	326	1555
Tin	Sn	118.7	232	2270
Zinc	Zn	65.37	419½	760
Cadium	Cd	112.40	321	778
Gallium (II)	Ga	69.0	30.15	?
Indium	In	114.8	155	above 1455
Thallium	Tl	204.0	301	above 1300
Potassium (Kalium)	K	39.10	62.5	757.5
Sodium (Natrium)	Na	23.00	97.5	877.5
Rubidium	Rb	85.45	38.5	696
Cæsium	Cs	132.8	26.4	670
Lithium	Li	6.94	180	above 1400
Bismuth (III)	Bi	208.1	270	———

(I) Melting and boiling points are given in degrees centigrade. The boiling points are only correct for 760 mm Hg air pressure.

(II) Gallium can be cooled carefully and slowly to about 20° centigrade without becoming solid; 30.15° is its *melting* point.

(III) Bismuth is usually *not* regarded a metal and belongs to the Nitrogen Group. It is mentioned here only because of its frequent use in making fusible alloys.

Explanation of the diagram accompanying the article: Fusible Alloys.

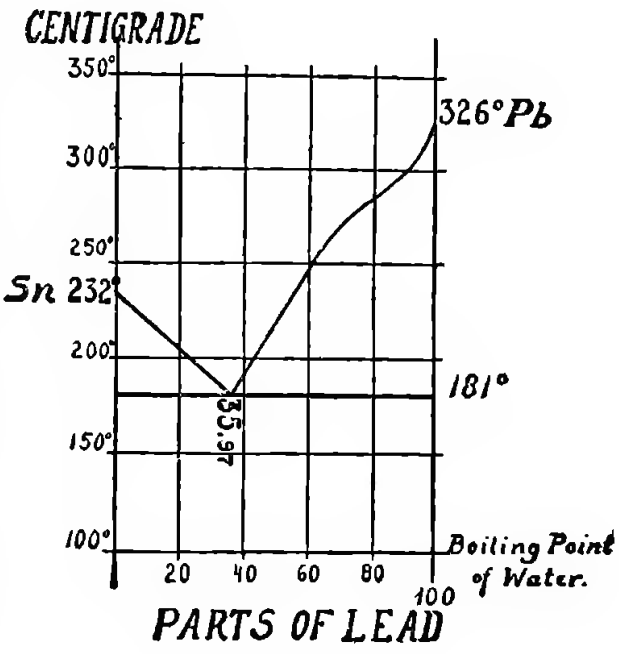
The diagram shows the eutectic relation between the two metals Tin (chem. symbol: Sn from the Latin *Stannum*) and Lead (chem. symbol: Pb from the Latin name *Plumbum*).

A mixture of 100 parts tin and no lead (i. e. pure tin) melts at 232 degrees centigrade, while pure lead melts at 326 degrees centigrade. The melting points of all possible mixtures of these 2 metals are below the melting point of pure lead. Those mixtures or alloys that contain less than 50 parts of lead have a melting point even lower than the melting point of tin.

The lowest melting point—181 degrees centigrade—is that of tin, with an admixture of 35.97 parts of lead. This alloy of 35.97 parts of lead and 64.03 parts of tin is called the eutectic alloy or the eutectieum of tin and lead.

"Parts" refers always to weight in this article, not to volume. Melting points and boiling points, in short all temperatures, are always given in degrees centigrade, the formula for converting centigrade into Fahrenheit is:

$$F = \frac{9}{5} C \text{ plus } 32.$$



The Great Ones

by Leslie F. Stone

With a roar, half pain, half rage, the huge hand squeezed, until Lok's motion ceased and blood oozed through those thick fingers——

THEY COME! The great ones come!" There was fear and hysteria in that wild cry, as the hunters came rushing pell-mell toward the cave-spattered cliff. "The great ones come! To the caves! To the caves!"

The women left the meager, rock-bound slope of the tor, their few rough tools left between the furrows. The fishermen at the water's edge swarmed

up the beach, the day's catch left where it lay. The weavers and the skin workers threw down their handiwork and grabbed at their sleeping babes; while the old men, who had been squatting around the community fire, caught up lighted brands before herding the young children that had been playing near by into the caves. *The Great Ones were coming!*

In less than ten minutes after the delivery of that dire warning not a single member of the tribe of Lunda was to be seen. Some had rolled huge boulders over the face of their caverns; others were building roaring fires that soon heated the stone at the cave mouth to white heat. And behind these boulders and fires crouched the hunters, armed with spears, axes, bows and arrows, even as they knew in their hearts what slight defense these were against the enemy. Chance alone could save them and their families. Neither fire, boulders nor their weak weapons could stave off the berserk great ones who came only to kill—kill—*kill.*

Just so had the ancestors of this people once crouched in caves, in fear of a common enemy, seeking to protect their women and offspring with fire and crude weapons. Had a man out of the twentieth century materialized in this era he would have believed that instead of being transported into the future he had, instead, been flung backward into the past. One could scarcely have believed that these shaggy-haired, skin-clothed people were the remnant of a once-proud, mechanized race moving rapidly into an age wherein it was to reach the heights of human existence.

But wait! What is that thundering sound? That great roaring? What manner of creature is producing this fearsome din that drives needles of terror into the hearts of the cave people? What new behemoth ranges the world in this far-advanced day and age?

From the other side of their crackling fires men watched, shivering as the enemy made its awful appearance, moving through the trees that masked the beach and cave mouths from the uplands. Fifty-foot trees were shoved aside like matchwood; underbrush mashed flat as the monsters crashed through. And the ground shook to their mighty tread.

Reminiscent in size to monsters of another time-gone age, they stood taller than the trees. But what made their appearance all the more horrific was the fact that *they were cast in the likeness of man himself!*

There were four in all, two of which stood over seventy feet high; the third somewhat shorter; while the fourth, a mere stripling, stood some forty feet. They had great barrel chests; huge, bloated abdomens that looked soft and pouchy; arms hanging heavily from wide, hunched shoulders; hands several feet in area, with thick, stubby fingers that dangled open; legs thicker than tree trunks, terminating in huge, flat feet that were longer than an ordinary man is tall. In color they were a grayish-brown with a scaly, wart-covered skin. Yet, hideous though the body, it was the head and face that struck real terror and repellence into the soul of the cave people.

For there was something horrible in the sight of those small heads, so out of proportion to those tremendous bodies —heads less than a fiftieth of the height, scarcely more than one foot high from chin to crown! There were no foreheads at all; the coarse, black hair seemed to stick straight up from beetling brows. The backs of their heads were all but flat, without any cranial development at all, so that from the side view they looked cone-shaped—and a very narrow cone at that.

On either side of these inhuman heads jutted forth floppy ears several times too large, which twitched continuously this way and that as sounds

from below came to the creatures. The faces themselves were ghastly dull and vapid. Set in deep, fleshy pouches were staring, red-rimmed, piggish eyes that somehow bore a soul-stirring evil in their witless depths. Although they had huge jaws, the chins were a mere recession of bone from the wide, sloppy mouths. And from the pale, flabby lips that exposed yellowed, broken fangs issued that terrifying, bellowing roar of the Brobdingnagian idiots.

For the great ones of the one-thousandth century were monstrous idiots with a wild, insatiable urge to kill—and kill. Nothing that stood in their way could hope to live. Even after the tremendous appetite was sated the animus to kill, to rend, did not abate.

OUR twentieth-century man would have had no explanation for this horrible travesty of mankind that was existing in that future age. It was for Prince Toms of the one-hundredth century to have visualized him, to predict his advent. And it was to his twin brother, Fergus V of Mediterraneania*, that he had given his prognostication.

Fergus refused to believe the results of his brother's researches. Calling Prince Toms to him he had sought to belie the truth with his shouts: "Gross giantism! Race imbecility! Fool! Blasphemer. You are mad! *Mad!*"

And pacing furiously from one end of the royal chamber to the other he had gone on to elucidate further upon the state of his twin's mind, while Toms stood at a window quietly gazing upon the rainbowed beauty of the city spread before him, framed by the jeweled waters of the Mediterranean.

"I realize that these revelations are soul-frightening, Fergus. But you cannot shunt facts into nothingness by words. I feel certain that with the matter brought before its attention the Congress of Science will turn its every effort toward mitigation and——"

"Quiet! Quickly, tell me, have you spoken to any one? Is there some one in your confidence to whom you have loosed your crazed ravings?" Halting before Toms, Fergus glowered at his diminutive twin.

For a moment Toms was disquieted. His ravings? Had he done wrong in coming to Fergus, who was so proud of his race? Was Fergus preparing to exercise his right to kingly judgeship upon his brother and his life work? But that could not be. He had to convince Fergus of the need of direct action. "Why no, Fergus," he answered in his quiet tone. "All our life you have been my only confidant. As I wrote you, I wish yours to be the honor of——"

"Enough of that! I see it all now you—you miserable runt! Somehow you have learned the truth—that you are my elder by half an hour—that but for your ridiculous size you would be upon the throne in my stead! And thus would you revenge yourself! By these lies you would drive me insane, reestablish yourself in your own eyes by pretending that our race faces ever-increasing giantism—and eventual idiocy.

"Look out that window, at the fair city below. Could a people that have created that border upon imbecility? Could a people that created perfection out of chaos—breed your idiots?

"Think you of the thousand cities like this—from one end of the globe to the other, of clean, happy countryside unmarred by not one unsightly object. Perfection—beauty—— Factories, mills, mines out of sight, underground;

* It was in the twenty-second century that war-weary mankind, tired of a hundred and fifty years of endless war between the three major exponents of government, had created the Congress of Science, to put an end to their dictators, their tyrants, their presidents. In turn, the Congress had created twelve nations, placed twelve kings upon the throne, whose only right to succession was their adherence to the mandate of the Congress, having realized at long last that the popular vote of the masses was, in truth, the minority vote of the spellbinders!

manned by machines operated through remote control by men dwelling in surroundings such as these. Think of all the world, a parkland, its wilderness no more than part of a great, cultivated garden!

"Think you of our perfect administration, of the Congress of Science, idealistically practical, our twelve wise kings trained to their vocation from infancy. Think of a world without real boundaries, a world wherein all natural resources are controlled for the benefit of all. Think of our weather control, the tides leashed, volcanoes subjugated! Think of a world of one race, one soul, one aim. And you prate of the death of such a mighty race, of disease, insanity! Look at me, brother, and dare tell me *my* descendants shall be idiots, you—you dwarf—you—you *freak!*"

FERGUS V could well be proud of his race, his physique. It had taken many centuries to produce him and his kind. It had taken an almost complete infusion of the blood of earth's races, excepting such savage and decadent peoples as the Congress had found as having nothing to contribute to the betterment of their fellow man. In a few short generations these undesirables had been weeded out through sterilization. Just as had all strains of the criminally minded, the insane, the diseased, the unfit been weeded out. The Congress had bred only for man's best tendencies, the strongest, the healthiest—black to brown, brown to yellow, yellow to red and to white. And the result was this one-hundredth-century man, with handsome, regular features, sturdy body, long limbs, thoughtful mien, intelligence —and great height.

In the twentieth century it had been noted that men, on the whole, were growing taller, inch by inch. Sons were taller than fathers. The end of the century showed an average height of five feet ten and a half inches, against the five feet eight inches of the first decades. The twenty-first added three more inches; the twenty-second three and a half. A scientific régime, synthetic concentrates of bone-and body-building elements was considered the reason for this growth. And in the twenty-fourth century, when selective breeding had begun, this growth was to intensify. Unconsciously, at first, then with direct intention, tall were bred to tall. From mere inches man began to increase his height by feet! Twenty-six centuries later the average man stood nine feet, two inches. And the dawn of the one-hundredth century brought about the birth of the twelve-foot-tall men such as Fergus V of Mediterraneania. Man was no longer Earth's puniest creature!

And Fergus was a perfect example of that race. Olive-skinned, wavy hair of raven-black, eyes so dark brown as to appear black, a fine upstanding, broad-shouldered, narrow-hipped body, features that were classically matched, he was the product of that selective breeding, bearing the stamp of the universal coloration brought about by the intermingling of all the races of man. All over the world you would meet the same, with few exceptions, an occasional "blond" with brown hair and even rarer, red, with eyes of hazel and less often, gray. Too, there were the midgets, throwbacks of their smaller-statured ancestors that made an unwelcome appearance from time to time. Yet, for all his perfection and beauty, the one-hundredth-century man had one flaw.

Queerly, the flaw had to do with the head, its comparative shortness in comparison to the height. Whereas, the old-time anthropological scale of human proportion gave man's head as composing one eighth part of his total height, the present-day man's head was but one tenth his body size!

Prince Toms, who was a perfect replica of his kingly brother, did not have this flaw; his head was in perfect one-eighth proportion. But there was a vast difference in his size. He stood but half as tall as Fergus—a mere six feet!

TOMS had listened to Fergus' tirade quietly enough. It was that last, ugly word that made him wince. Even a scientist does not like the appellation of "freak." Unconsciously, he stretched all of his body to its fullest, and in a scathing voice declared, "And I thought you above all that, Fergus. I thought you and I, regardless of our difference in size, were equals in soul. I thought that like your size, you were big enough to put self, race pride behind you. I thought you were big enough to recognize truth. But you twit me with my lesser stature, prattle of revenge, personal egos—perfection!

"What you do not realize is that, with its very aim for perfection, the Congress has created only stereotyped stagnation—and worse.

"As if size matters to a scientist, a delver into truths. As if being a *freak* could color my studies. No doubt, it would puzzle you to know I am actually happy in my diminutiveness, that sometimes it is a convenience. Think you it matters that I am not king, a puppet moving to the guiding strings of the Congress? Think you it matters that they sterilized me? No, in that I can be happier, knowing that my can't-be-born offspring shall not inherit the diseased glands of our race!

"Fergus, believe me. Every word I have spoken, every word of my monograph is true. My researches, my laboratory experiments prove over and over that the race moves toward gross giantism and imbecility! It is already evident! The shortness of your head! I have developed rats to a length of seventy-two inches, with heads that have grown no more than those that are twenty-four inches long. Does that mean nothing to you? Does it mean anything to tell you our race continues to grow—beyond adolescence—that some of our oldsters are eight—ten inches taller than they were at twenty-five years of age?

"Ah, if it but would! For this disease, Fergus, is not new! It has always been with us in abbreviated form. All creatures, apparently, carry its seed in their genes. At one time in history it appeared that all species of animals would never cease growing. Some species became extinct; others saved themselves. We shudder at the immensity of the dinosauria of the Mesozoic Period, eighty-foot monsters with minute brains. Can you picture that time when man reaches such heights?

"In our own day we have seen the disappearances of whole species. That behemoth of the oceans, the whale, which is no more to-day. Poor things, they grew too large for their own good. They killed themselves by growing bigger and bigger until, too huge, they could not defend themselves against smaller, swifter foe. Diseased, they transmitted the disease to their young in blind mate instinct for bigger, stronger mates!

"Over and over animals have become extinguished by this dread disease; others saved themselves ere it was too late. Such an example we have in the elephant and the mastodon. One is extant to-day because it remained normal, like size bred to like size; the other was gone before the dawn of history, because it bred too large for its own good. Once, it appeared that the horse, originally an eleven-inch creature should grow itself into extinction, but a balance was struck and it remains, *smaller* and *smarter* to-day than even its twentieth-century forbears! *For there is a balance that must be preserved if the species is to survive.*

"It is well established that our own ancestors were three to four feet high. In the early centuries midgets of that size were common, and there were even entire races of midgets or pygmies existing until the twenty-fourth century. But because each species seems to carry a seed of the disease of giantism in its linking chromosomes, man has been able to increase his size artificially. All our history mentions the giant. There were the Titans of the Myths, the Cyclops of the Greeks, but they are not to be compared to those that come!

"Science knows not that it wields a two-edge sword by overfeeding the growth glands. An overfed man can develop fatty degeneration of the heart; overfed growth glands*, can also develop degeneration! And our race, of consequence, must die because its saviors, its throwbacks to normalcy, are sterilized!"

FERGUS sought to stem the flow of his twin's discourse. But Toms knew his rights. "You who have become my judge shall hear the full merit of my plea for civilization, for you are not only judging me, but your veto upon my researches shall also be the death knell of your own proud race! Hear me through." His gentleness was gone.

"We shall now consider, rationally," he continued, "what happens when a species of animal changes its own size scale. Back in what we like to term the dark ages of politic conflict, two scientists, Cuvier and Dubois, through elaborate algebraic calculations, established the fact that the specific brain weight of a species must not fall below a certain proportion in relation to the weight of the body, if normal intelligence is to be maintained. For instance, among monkeys, the smallest individual may not be smaller than the ouistiti, that has a brain one twenty-fourth its total body weight of ten and a half ounces. To reduce this mammal a third of its size, it was found that to retain the same amount of intelligence it previously possessed, the creature would require a brain one sixteenth its body weight. By the same calculations man, to retain his normal intelligence, cannot weigh less than thirty-three and a half pounds. Less than that and he loses some of his thinking powers.

"Now, to reverse this order. Using the Cuvier-Dubois method of calculations for my working basis, I set out to determine the opposite result: how huge can a man grow and retain normal intelligence? Referring again to the twentieth-century brain studies, I learned that the average brain of that time weighed from forty-eight to forty-nine ounces at full growth, although there are instances of brains weighing as high as sixty-four and a half ounces. Some of these larger brains were those of men of high intelligence—but just as many, if not more, of the large brains belonged to epileptics—and insane. Charts did show, however, that the larger the man, the larger the brain. And here I came across a point of great interest.

"The brain, as you know, continues to grow beyond adolescence, up to the time of middle age. After that there is a slight reduction, as of contraction. However, whereas the brains of both a five-foot and a six-foot-tall man grow accordingly, and the brain of the six-foot-tall man is larger than that of the smaller, actually, the brain of the five-foot-man grows larger *in proportion* to his size, than that of the larger man!

"And this brings us to the proportion of the brain to the weight. The average Englishman of the twentieth century stood five feet, eight inches and weighed one hundred forty-four pounds. With an average brain of forty-eight ounces—three pounds—it is found that his brain weighed just one forty-eighth

* Thyroid and pituitary glands.

his total body weight. Consider a man weighing three hundred pounds, a brain sixty-four ounces, and we have a proportion of but one seventy-fifth the total weight. Therefore, we can judge that to retain normal intelligence a man's brain size can range from one forty-eighth to one seventy-fifth of his body weight.

"It is natural to infer from that that as man grows in stature and weight, his brain grows with him, always keeping its proper proportion. Thus, should a man double his own height and weight he should, likewise, double the size of his brain. Our average man of to-day weighs five hundred and twenty pounds. If our supposition is correct, his brain-body proportion will be about one sixty-fifth, a proportion that remains, as you see, well within bounds.

"But alas, Fergus, nature has not followed this rule! I was present at the weighing of the brain of Menor, lately of the Congress of Science, who died three weeks ago. His brain weighed exactly eighty ounces—five pounds! And since Menor weighed five hundred seventy-five, we find that his brain-body proportion is one one hundred fifteenth! In his growth from six to twelve feet, man's brain has grown but two pounds!

"How wrong were those who dreamed of the day when man's brain should grow so large as to be too heavy for him to carry! Had they even guessed close to the truth they would have all but driven themselves mad. And the truth is even worse, Fergus, than I have already stated to you. Actually, man's brain reached the peak of its growth fifty centuries ago! For when he stood but nine feet tall, man's brain weighed eighty ounces. And at this weight the brain reached its full growth! No matter how great in size man continues to grow, his brain shall remain the same size!

"Do you grasp what that means? True, man's intelligence does not depend wholly upon its size. Intelligence grows with the brain's complexity of its convolutions as it folds in upon itself. But what must happen when that folding process ends? Can you tell me that, Fergus?

"Well, I shall tell you—for that has happened. I have examined brains through twenty centuries of man's growth—and just as the brain has ceased to grow at eighty ounces, so had it, twenty centuries ago, ceased to form any more convolutions! Can you see now what has happened? Do you understand your perfections of this day, the meaning of your awful duplication? Man has lost his initiative! No new idea—excepting this one—has been born for twenty centuries.

"Tell me, Fergus, that I have not come too late. That you—and the Congress are still capable of acting and of doing——"

"No! No! I can listen to no more. I dare not believe this madness of yours."

AS IF he had not heard, Toms went on, "Have I told you of those six-foot rats of mine, with heads one fiftieth their body size? Poor things. With no brain to speak of, they lost all sense of proportion. They could not remember where their nests were, what were the proper foods to eat. They became wholly feeble-minded, then insane. As it grew increasingly difficult for them to find sufficient food for themselves, they turned cannibal. In the end they turned upon their own mates, their young. At last, in berserk rage they wanted nothing more than to rend, tear and kill——

"Can you picture a man standing thirty feet, with a brain weighing eighty ounces—forty feet, perhaps, or even fifty? What amount of intelligence could a man weighing five thou-

sand pounds be expected to have with a five-pound brain?"

"No! You are wrong," shrieked Fergus. "Hideously wrong. I can bear no more! I refuse to listen to more of your blasphemy, your sacrilege! You are mad, insanely mad. As your lawful judge, I condemn you!"

Prince Toms' shoulders sagged. He had failed utterly. He was a fool to have trusted himself into his brother's hands. But on second thought he realized that it did not matter. His twin was merely a reflection of all his race. Any man on earth would have done the same thing! They could not have helped themselves. For just as they had bred physical likes, so was the mental and spiritual being a carbon copy of all others.

But wait, perhaps there was still time to open Fergus' eyes. He had his right of rebuttal, the right to ask for another chance.

He said, "Of course, you will allow me to present proof of my statements, Fergus? Send for Torgo, our father's old servitor, who performs small tasks in the palace. See him before you pronounce final judgment upon me—and my researches."

Without expression, the king nodded his head and lifted a hand to his mouth. On his finger was a ring whose center was a delicate speaking diaphragm. He spoke a few words into it. Five minutes later an overtall, stooped figure, with snowy hair and dull eyes, entered the royal chamber. He looked inquiringly to Fergus, but it was the midget who spoke to him.

"Torgo," he asked gently, "how tall do you stand?"

Torgo glanced up in surprise. "Why —your highnesses, I am eleven feet, ten and a quarter inches. It is here, tabulated between my shoulder blades." And he tugged at his upper garments to show the indelible markings that had been tattooed there on his twenty-fifth birthday. They described his physical appearance, bodily measurements, birth date, parentage and blood lines.

"Will you kindly come here—stand beside his majesty? It's quite all right. Do as I say."

Fergus watched the old fellow shuffle to his side.

"Stand straight, Torgo. Raise your head. Throw back your shoulders. Up man! Ah, that's it. Now, do you see, Fergus? Torgo, who at twenty-five was eleven, ten and a quarter, is twelve feet, several inches tall at one hundred and thirty! You who were twelve feet at twenty-five have grown a few inches yourself, possibly, yet Torgo tops you by an inch or two!" Toms sighed.

"And thus grows all the race—just as the reptiles of ancient times continued to grow as long as they lived! Had they but measured Menor's length, as well as his brain weight, they would have discovered that he had grown eight or nine inches since adolescence. But all who associate with the oldsters are also growing in like proportion. They never measure themselves.

"So now I beg of you to accept the truths I have placed before you, Fergus. All I ask is that another scientist, several perhaps, but study my researches, repeat my experiments, for I know that they can do no more than come to the same conclusions as I! In humanity's name, I demand it!"

"*No!* These things are lies—*lies* I tell you. Lies!" Fergus turned upon the servant. "Torgo, confess the truth. You are not he who was given this tattoo! That you usurped another's place to hide a crime of your early youth! Confess!"

Misbelief, bewilderment, fear swept the old man. He muttered and stammered, mouthing words before he could control his half-paralyzed tongue. "No —no, sire, do not accuse me. I am Torgo. I swear it. How in the name of your revered father could I—*change*

this mark? Oh, sire—sire——" Then, suddenly, he pitched over upon the floor —dead.

"It was too much for the old heart to stand." Toms sighed.

"He lied, I tell you. The tattoo is changed. There was such a case in America ten years ago. His guilt killed him."

Again, Fergus lifted the speaking ring. "There is a madman in my chambers to be executed instantly. And send Bejo. I have a criminal case awaiting his attention. Hasten." And plucking

"The great ones come! To the caves! To the caves!"

from a table the sheets of paper that held Prince Toms' lengthy report he tore them across again and again.

Toms watched him silently, pityingly. He did not mind dying, but he did mind that his work must go with him. Perhaps. had he searched far enough, he would have found some one to listen to him. The real pity of it all was that they must go on sterilizing avatars like himself, who alone carried the seed of sanity in their genes. The race had condemned itself to extinction.

BUT PRINCE TOMS had erred in one equation. He had considered that the future of the race lived in its avatars. But throwbacks have a habit of breeding, for the most part, in the likeness of their direct forbears; they rarely breed like. It is the sport or mutation that is responsible for differentiation and modification of a species. The human genus was to survive only through these persons born with immunity to the disease of their race.

Actually, the civilization of Fergus V of Mediterraneania, and his kind was to continue almost unchanged for practically one hundred centuries more, carried forward upon the momentum imparted by its upward surge. But even as Toms had predicted, the body continued to increase in size with the brain remaining static at eighty ounces. And with no push from within, the skull, likewise, remained almost stationary, growing just enough to allow for the expansion of the facial bones.

Again, Toms had been correct in saying that his was the last new idea. Wholly imitative, repeating the practiced motions of its forbears, the race had nothing new to offer. The only change was in man's accelerated rate of growth. Whereas, it had taken eighty centuries for man to double his size, in the hundred centuries following he not only doubled that height, but added another six feet besides!

It is to be expected that with this increase in size the new giant would have built new homes. Instead, he simply made the old do by knocking out the second-story floor of his old house, making himself as comfortable as he could. Nor did he design new furniture. Either he joined two or more items together, else contented himself upon the floor.

Yet, that was not all. Man began to forget how to use the implements science had given him. Even if he had thought to build new furniture, it is to be doubted that he would have known how to go about it. And as time went on more and more was forgotten. Although dwelling within the beautiful cities of the past, they gradually lost the ability to keep them in repair.

As machines wore out, one after another, cities had to be deserted, because of the breakdown of water or light systems. Then, as the air service began to fall apart, city after city lost direct contact with the other. One day the giant radio-television station, that had served all the world, went out of commission and no one knew how to repair it.

For many centuries all world commodities were delivered through a vast system of pneumatic tubes. Now, the system began to break up. Factories and mines no longer supplied the cities with even the necessities of life. It was found that the locations of many factories, mills and mines had been forgotten, were lost. By the end of the year 26,098, it was evident that, to keep himself alive, man had to revert to the tilling of the soil with hand tools.

Once a machine ceased its function, no one had the initiative to examine it to discover what had made it go. But had it not been for the farming machines they would not even have had any idea how to go about farming for themselves. Ripping the plowshares from the machines themselves, those

who had seen the machines in operation went about imitating its motions. Luckily, each machine carried hundreds of these implements.

Had an intelligence quotient been taken at this time it would have shown that the large majority of the people were more or less feeble-minded. Here and there was to be found a man or woman slightly above average. It was they that made the last attempt to lift their race out of its slough of mental apathy. But once they managed to get the thought across that to eat, man must plow, plant and reap, it was simple to keep their slaves at their toil. On the other hand, it was sometimes just as difficult to halt the work at sundown. Otherwise, many would have gone on working until fatigue killed them.

It was at this period that the eugenic board, which had somehow existed all these centuries, more or less, broke down completely. Men forgot to make a gesture at imitating the card indexing of their ancestors. From that time the little ones began to collect into settlements of their own.

THESE PEOPLE were on an average of between six and nine feet tall, although there were occasional five-foot and ten-or-eleven-foot men and women among them. They differed from the old race in several ways: first, they had heads more in keeping with their bodies; second, they were far more intelligent. Yet they were to make a mistake that was to cost their descendants dearly. Entirely shunning the old cities, they lost their one chance of grafting the knowledge of their ancestors upon their new organization.

Born when the cities were scarcely more than rubble heaps, filthy and filled with disease, the machines mere heaps of rust, their own parents dull-witted, eking a miserable existence upon the crumb heap of the past, they had not recognized the values upon which the cities had been built and knew nothing of the great libraries, of the stores of records lying dust-covered beneath the fallen stone. They simply made their own start from that period of their race's decadence. Theirs was the beginning of a new iron age.

Not all their offspring were as themselves. They could never know when a young giant would be born. In fact, at first, the percentage was high, as was the death rate of the mothers. And the new race would have nothing to do with them. They were determined to keep a standard of their own. They, the erstwhile freaks, were for prohibition of the appearance of freaks in their midst. All overlarge young were destroyed at birth. Those that showed an inclination to grow too rapidly were done away with. Parents who persistently gave birth to giant offspring were forced to leave the settlement. They, the despised, were now seeking race purity. Without knowing their past, they were disfranchising the giant.

In the meanwhile, all was not going so well with the old race. Such cities as were still in use, because of their proximity to natural water sources, were becoming offal heaps wherein disease and terror grew year by year. Death stalked the streets at all hours and it appeared as if the end of the race was at hand.

But another factor was arising to bring about a complete severance with the old civilization: by hundreds people were becoming mildly insane. It was increasingly difficult to keep them at work in the fields, or even at the simpler tasks of shepherding sheep, herding cattle. They were quickly becoming a drag upon their fellows and there was but one solution: to turn them out to fend for themselves best they could!

That was an error. For these outcasts drifted together, roved and ranged

as they pleased, either stripping the wilderness or raiding and pillaging the fields and storehouses of those who had turned them free. Mostly, these people were not vicious—simply hungry. At first they were content to glean for what they could find on the edges of the farm lands. But that did not last long. Here and there a homicidal maniac might do serious damage. The dull-witted farmers hardly knew what to do with this new situation. They tried to defend their own with clubs, but as the company of the insane grew, the problem became acute.

Toiling from sunup to sundown, the farmers were barely able to grow enough food for themselves and their families. To halve their rations with their unfortunate brethren meant near starvation for them all. After repeated attacks of ever-increasing bands of outcasts that were breeding among themselves as rapidly as the city dwellers, the time was to come when there was no more seed for planting. Driving their herds before them, the farmers were to desert the cities and take their chances in the open with their enemy.

But that was no solution. Their herds decimated by both their own gluttony and that of the large, wandering bands of outcasts, man slipped lower down the scale of civilization from herder to hunter, taking food where he found it. And now, as there was no longer anything over which to fight, the outcasts were outcasts no longer. Insane and dull-witted roved together in the never-ending search for food.

And all the while humanity continued to grow. By the three hundredth century the average full-grown male was more than forty feet tall. And it was not unusual to see oldsters several feet taller.

All the world they roamed, foraging throughout daylight for food to fill their great stomachs. Each adult was now capable of eating two full-grown cattle a day and still feel the gnaw of hunger. But they could not always depend upon meat. The harvest of a single, well-laden fruit tree was considered a half-way decent titbit for one adult. By sitting in a field of wild melons or a vegetable or grain patch a man could manage to take off the edge of his appetite by devouring everything within reach of his long arms.

This giant no longer bothered with the niceties of cooking his food, any more than he bothered to peel or skin it. Necessity drove him to fill his growing maw with everything within reach. Such bones as were too large to go down his gullet he cracked and sucked, and he was developing the ability to digest all sorts of roughage.

ONE can wonder that any other living creature was able to survive these Gargantuan appetites. Yet with all the world rapidly turning into a wilderness, the animals, with unrestrained pasturage, had become increasingly prolific. Domestic animals that had been bred for countless centuries for the betterment of their own powers of regeneration did good part to regenerate the world with their kind. Particularly in those parts of the world where man first deserted his cities, the herds had developed unmolested.

Long ago man had done away with earth's predatory beasts, so that aside from drought, flood, famine, insects—until man again found them—the meat animals thrived wonderously. The forest had become filled with swine. Beaver, marten, otter and dozens of the smaller animals were again swarming the streams. Rabbits, mice, rats rampaged through the grasslands. Thus had the world prepared itself for the coming of the most predatory beast of all time: man himself.

And man, or that awful travesty of man, prospered through the years, even

as he grew more witless. When herds of a locality grew scarce, deserting to greener, fresher pasturage, the great ones followed. And it was in the course of these wanderings that they discovered the little ones, dainty, tasty morsels that did not have the fleetness of the herds to escape their groping fingers. It is to be doubted that the witless monsters were able to recognize the little people as creatures like themselves in all but size.

With the coming of this awful menace the little ones had to change their own ways of living. No longer could they dwell in the open, cultivating broad fields of grains, pasturaging great herds. Let a band of great ones stumble against their land, and all achievement was wasted, acres laid bare, herds devoured or scattered, themselves on the run. And in running they were no match for the terrible giants. Once the giants had discovered their existence, they went out of their way to find them, smelling them out, sighting them from their own great heights.

It did not take the little ones long to recognize the fact that unless they deserted their villages they would soon be no more. They tried at first to save their herds, to keep ever on the move. But the great ones were everywhere, appearing suddenly from one direction or the other in bands of twenty, thirty or even forty individuals.

And so, through necessity, the little ones retraced the steps of their ancestors. Gathering into small tribes, sometimes mere family groups, they nested in the most inaccessible havens they could find, in natural caves, in burrows in the earth, upon islands far from shore, hoping against hope that the great, mindless ones would not find them. Yet, they were found. A hunter moving through the trees, a child that had wandered afield, a woman scratching at a bit of earth were sufficient to bring the bellowing monsters down upon the tribe. And no cry was more dreadful than "The great ones come!"

THUS, hundreds of centuries after Prince Toms had sounded his warning, the people of Lunda waited, shivering behind their fires, as four great brutes with idiot faces shoved the trees out of their way in anticipation of the delicate morsels of flesh hiding in the rock pile of the tor.

Behind his cave fire, Gorg, the seven-foot hunter, leaned upon his spear as he peered through the smoke at the oncoming leviathans. So hot was the fire it blistered the skin of his face, arms and torso; yet all the while his body shook and trembled at the sight before his eyes. Brave of the brave, he could not hold back that shiver running through his stocky body. Would the fact that his cave was in the lowest tier on the cliff side protect him and his own? Those that dwelt higher faced the greater danger.

He counted as they came. One, two, three—— Two gigantic males and a female. No, here came the fourth, trailing the others. This was a small pack, but sufficient to account for every man, woman and child in the caves. Gorg's grandfather had told him of raiding parties numbering eighteen, twenty members. His father had recounted tales of groups of ten, twelve. But Gorg knew that nowadays a pack of four monsters was large. For some reason of their own they were moving in small groups. Gorg had heard stories of how the terrifying monsters fought among themselves over the spoils.

What Gorg did not know was the fact that the giants were numbering less each generation. Less and less young were coming into the world. So ferocious had the miserable monsters become that they were likely to kill the mate for whom they had just fought

and killed another male, forgetting in the blood lust why they had sought her out.

Furthermore, if a female did become a mother she was just as apt to devour her own young before it got its walking legs—she or some other. The maternal instinct had to be increasingly deep for a female to carry its young in arms until the little one could fend for itself. And even if food were plentiful, let the little one make a single move that irritated its mother and she might, in insane rage, toss it from her. Again, it was rare for a mother to recognize her own, once it had left her arms. A foster mother might accept it in place of one just lost, or again, a male might decide to dine upon it himself.

Considering these factors, together with the growing tempers of brutes who fought each other to the death on the slightest provocation, it was to be doubted that with their rapidly lessening numbers the giants could live out another century. Just as nature had eventually turned her back upon her monster offspring of other ages, so again she was preparing to rid the world of its present scourge. Should Gorg's children live through the present raid, they had good reason to expect to live until that day when the last monster should be gone!

UNAWARE of any of this, Gorg watched the brutes approach the cliff, cringing at the sound of their excited yowls and yammerings, growing white and shaken at the first gurgling shriek that told him that one of the monsters had made its first kill in the caves above. Then came the earth-shaking roar, as the two males fought over the prey. Through the smoke of his fire he could see their great feet and tree-trunk legs, as the pair danced and stamped around each other, while the female, making the best of her opportunities reached into the caves on the crest of the tor.

Without turning his head, Gorg spoke a few words to his family. But he did not move from his place behind the fire. By the sound of their movements, he knew they obeyed him, creeping into the "safety room" he had long since prepared for this day.

The settlement of Lunda was comparatively new, having existed some forty years. Here had come Lunda and a half a dozen companions who had escaped a raid of the great ones far upcountry. Here they had believed themselves safe, out of the path of the roving monsters. Most of the present tribe had been born, grown to manhood, raised families with never a sight of a great one. And it had become their legend that they had naught to fear. But Gorg refused to believe that. He had readied himself against that day when the great ones should find them. He had begged his fellow tribesmen to follow his example. But only a few had been willing to do so.

His preparation consisted of digging a second cave out of the old rock behind the cave in which his family dwelt. It was a small, dark hole, but large enough for the five of them to crouch together, seeking comfort in each other's arms. Since, here they kept a portion of their winter's stores of food they could stand a siege of many days, once the door was pulled to.

The door of this crude cyclone cellar was a boulder some five feet across and as many feet through. It appeared immovable, but through long fire-lighted evenings Gorg had carved out its crude knob with stone and flint. By means of the knob he could get sufficient purchase to drag it across the opening of the chamber. But he could not bring himself to join his family immediately. He was held to his place at the cave mouth by awful fascination of the scene being enacted before his eyes.

For while the adult monsters were squabbling over their spoils, the forty-foot youth had flanked them, and now on hands and knees was grubbing in the lower caves for his share. Youthful though he was, there was nothing about him to stir either admiration or pity, no sweet comeliness of the adolescence to attract the eye. He was, if anything, more idiotic, more hideous in his slobbering anticipation of the stolen sweets than his older companions. His dangling mouth drooling little rivulets of saliva he peered nearsightedly, with his little piggish eyes, for signs of life behind the fires.

Tentatively, he reached forth a ham-like hand to one opening, and with a wild squeal jerked it back as the fire bit it. But his dull brain did not register the fact that what had hurt might come again, and he repeated the same action, with the same result. The second burn plunged the poor, simpleton brain into demoniacal rage, so that when the hand plunged into the fire a third time the heated brain took its revenge upon what lay behind the fire. The next instant the hand came forth, little fingers of flame clinging to its fuzz and flesh, while Lok, the carver of ivory, struggled to free himself from that terrible, constricting clutch.

With a roar, half pain, half rage, the huge hand squeezed until Lok's motions ceased and blood oozed through those thick fingers. Sight and odor of the blood drew insane giggling from the monster, as it lifted the gory thing to its fanged mouth. Five times the hand was thrust into the cave. The last victim, still alive, went into the grinding mill of wide molars.

It was then that the female giant discovered what the youngster was about. With a whimpering yowl, he went over backward, the sound of her hand on his flesh falling like a clap of thunder.

SICK OF HEART and stomach, Gorg could stand no more. Retreating to the back of the cave, he crawled into the safety hole and began to tug the boulder into place. He felt certain that finding the cave empty the great ones would not think to pry his boulder loose. The weight of it taxed his strength sorely. Their arms around his thick torsa, his mate and their fifteen-year-old son helped him drag the stone into place. At long last, with less than an inch of light showing around its rim, Gorg ceased his labors. Exhausted, he sank to the floor, feeling for his spear at his feet. Should an invading hand actually tear out the boulder, he would sell the lives of his family and his own as dearly as he could.

After a while he spoke out of his misery, "There should be a way to kill them ere they find our caves—else head them off——"

"Father, I—I have been thinking. We have arrows, why could we not kill——"

"And have them turn upon us to wreak vengeance?"

"No, not that. Still, they rouse to anger quickly among themselves. Would they not think that the missiles were hurled by their companions—and turn, one upon the other?"

Gorg loosed a shout that filled the tiny chamber with a great volume of sound. When it died away, he exclaimed, "My son, you shall be a great hunter. I see it! And it took a lad to show the way! When these great ones depart, son, you and I—shall follow and——"

Lying there in the darkness, waiting for the bellowings of the monsters to die away into the distance, Gorg lay dreaming of the greatest hunt of all—that was to come. For it is by dreams such as these that man, so to speak, has pulled himself upward by his boot straps!

by

R. R. Winterbotham

Rolling himself into a solid mass, Einleill threw his entire being into the body of the professor——

EINLEILL

At last—he realized—that Aristotle was right

FIRE, Earth, water and air—the four elements of the Greeks—were a fallacious groundwork for any philosophy, Professor Philemon Jones knew. But the Greek wise men, in their blind, subjective gropings, had been so near right in so many things that the professor could forgive a few errors.

Euclid's geometry, for instance, and the Greek atomic theory, the speculations that the Sun, not the Earth, was the center of the universe, and that the Earth was round were positively on the right track and, considering the lack of scientific instruments, the theories possessed a high degree of accuracy. Surely no people came nearer the truth by pure guesswork than the sages of glorious Greece. Without scientific paraphernalia they had calculated the Earth's circumference with a small degree of error. They had estimated the Sun's distance at only one third less than its true amount.*

Then Professor Jones realized that, in spite of its precocity, Greek philosophy had overlooked something important—and that Professor Jones had overlooked something.

It happened after his Thursday-afternoon lecture on "Substantialities of Hellenic Philosophy." The students had left the classroom and he became aware of a delicate perfume in the place. He raised his thick-lens glasses. At first he saw a blur, then a round face—a dimpled face displaying a smile beneath golden hair. He had seen the face before—yes, she was one of his students, a Miss Hockenschmidt—Sylvia Hockenschmidt.

But he had never noticed her particularly. He had gathered from her test papers that she was dumb, unusually so.

But now—alone in the room with her—the instructor felt vague stirrings within his ribs, as if he was on the verge of a discovery the Greeks had overlooked. The Greeks had a philosophy of love, but it was separate and distinct from the philosophy of Socrates, Plato and Aristotle. Professor Jones' heart pattered.

"Professor, what is the nebular hypothesis of the Greeks?" she asked. "You mentioned it in your lecture——"

A gulp and the answer somehow came to his lips. "It was a belief of the Stoics," he explained, "that the universe was formed from a fiery vapor. Successive stages of the evolution of the Earth and the universe from this vapor may be considered a forerunner of the modern hypothesis." The professor's heart was not in his work. The young woman was quite attractive.

A sleek-haired young man entered. "Oh, there you are, Sylvia!" he exclaimed. "Come on, we've just time for the afternoon dance!"

She smiled sweetly at Professor Jones. Then, slipping her arm into that of the young jackanape, she left.

Professor Jones sighed. Then he stirred himself. He was a man. She was a woman. He would be primitive. He would win her from this young stal-

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* Posidonius, 100 B. C., determined the circumference of the Earth as 240,000 stadia, about 28,600 miles. He was also credited with the calculation on the Sun's distance.

wart. What good was Greek philosophy if it couldn't win a woman?

Professor Jones prepared to fight for the woman he had just discovered he loved. "As Heraclitus of Ephesus said: 'Conflict is the father of all'!" he muttered.

IN THE MAW of sunless space slept a misty form. For hundreds of years it had slept as it drifted through space. Now it stirred feebly as the first warmth of the Sun's rays struck its misty body.

The creature was more like a cloud than a physical substance. Its body cells were more loosely packed than the molecules of a comet's tail. No human eyes could have seen it. This creature was Einleill, who fed on cosmic rays and who breathed energy.

Einleill drifted past Neptune and Pluto. He crossed the orbits of Saturn and Uranus.

"Dull and uninteresting, this universe," he decided. It was not a speech and not a thought. He used the means of consciously communicating his ideas to himself that was used by the inhabitants of the planets of Sirius, which was quite different from that of human thinking. Einleill had never thought, yet he was an intelligent creature.

Einleill found Jupiter, Mars and the planetoids uninteresting. He was about to disregard a quite heavy planet just rounding a turn in its orbit when he felt an unusual sensation.

"My word," gasped Einleill, "what kind of a world is this?"

Of course, this was not what he said, for he did not speak. He still was using the thought method of the Sirians.

Einleill was instantly aware of life on the planet; for his body, delicately attuned to energy of all sorts, was cognizant of life energy. But the instant he drew close to this small planet of this obscure star of Absolute Magnitude 4, he knew that devilishness was being spawned on that wet, cloudy rock that might stir the universe around it.

It was then that Einleill had his first thought. He grasped at once that the idea consciousness of the inhabitants of the planets was accomplished in a different manner than that of Sirius' satellites.

Einleill's first thought was an imageless thought. Imaginal or sensational thinking was beyond his scope. The old school of psychologists might argue that to think of a world might require an image of other worlds or a sensation of what a world is like. But certain American and German psychologists will perceive that a *first* thought must be imageless, for there is no prior experience in thinking upon which the thinker might draw.

Following the first thought came others. Einleill learned to think rapidly. But he had not located the source of the disturbance on the Earth. Certain organic chemicals found in abundance on the planet were probably responsible. Nothing else seemed to possess properties of life.

"I shall examine these compounds one by one," said Einleill.

The creature of space drifted to the surface of the planet. At the bottom of a sea he found a round substance flattened into a disk. Einleill sensed that it was an oyster, and that it was thinking.

The oyster was thinking about a pearl. A pearl is of value to an oyster only because it causes an oyster to think. Riches to oysters are not pearls, but room inside the shell. Poverty, being a source of annoyance, had driven the oyster—just as the thought irritation from the Earth had driven Einleill —to thought.

After a close analysis made by drifting through the cells of the oyster's shell and body, Einleill determined that it was not the oyster that had caused the thought irritation.

Einleill, moving from the sea, turned his attention to another creature. This one was covered with feathers and it flew from tree to tree. Einleill's mind deciphered that it was a buzzard waiting for something to drop dead.

Einleill examined elephants and ants, cassowaries and bones of dead Æpyornithiclæ, for at first he was unable to tell if the organic compounds thought after death. Thought processes of lower animals were very feeble.

Then the creature from space sought for the source of the irritation in the Tatu armadillo in the jungles and among the Otariidæ of arctic coasts. None of these, and neither worms nor jackasses, were the creatures he sought.

All, some more than others, seemed to think. But the thoughts lacked variety. There was a sameness in the pattern: food, love, pain, warmth, danger. These things could not have been the source of irritation.

Then he saw two strange bipeds, one wearing a flowing dress and the other dressed in trousers. The creature in the dress had blue eyes and golden hair and was twittering like the feathered creatures in the trees. The one in trousers was solemn. He wore thick glass lenses over his eyes.

"Anaxagoras of Clazomenae held that there was a divine *Nous,* or intelligence, who brought order into the chaos of things," expounded the creature in pants. "From there we can trace the development of Greek philosophy to Diogenes, his younger contemporary, who——"

"—searched Athens for an honest man!" twittered the other, younger creature. "Oh, Professor Jones! How do you remember all those things?"

"Ahem!" The professor straightened his necktie. "Well, you see, I've studied a lot——"

"But, really, don't you think it's a lot nicer to sit under the trees and look at the flowers and things? Don't you ever get tired of Greek philosophy?"

"Well, Sylvia—er—Miss Hockenschmidt—I do relax once in a while. Why not sit here?"

Einleill fumed static into the ether. The same old formula. He had watched a mama worm pull the same thing on a papa worm to swindle him out of a mouthful of fresh garbage not so long ago. These creatures in pants and dresses were very uninteresting. The creature of space turned its attention to wildcats.

FROM TIME TO TIME, as Einleill examined plant and animal life of this world, glutted with organisms, he ran across these mentally unbalanced bipeds. At first he disregarded them as cases already examined and discarded and unfit for study. Then he caught certain subtleties and cunning amongst various individuals of the species. He took more interest.

He noticed that while the basic emotions of these bipeds were the same as those of the horned toad and the chimpanzee, the creatures went a little deeper and did things in a more round-about fashion. Among themselves, they regarded the most involved thinking as the most intelligent. When a person drove directly to the point he was looked upon as simple. When truth manifested itself in a thousand ways, a long explanation for each of the thousand ways was given. The truth was disregarded.

For instance, Einleill noticed that when a lion became hungry it hunted and killed an antelope or a zebra and fed on its carcass. It was the natural thing to do. These two-legged creatures had a custom of requiring a creature in pants to do some untoward thing for another creature in pants. For the service the latter pant-wearer would give the former a piece of paper or bit of metal. The receipts would be traded to still another biped for something to

eat, which the recipient would share with several others.

Einleill did not question the merits of the system, but when the bits of paper and metal seemed to be more important than the things to eat, he wondered. The lion did not hunt for the pleasure of it. The lion hunted to eat.

"A crazy species such as this biped race is likely to do anything," decided Einleill. "I must watch them. Perhaps they *are* the cause of this thought irritation."

Einleill chanced to return to a spot near where he first saw Miss Hockenschmidt and Professor Jones. Within a room in a stone building he saw Professor Jones standing before a large number of younger bipeds. The young female, Miss Hockenschmidt, was in the group and Professor Jones, seemingly, could not keep his eyes off her.

"You have made a common mistake, Sylvia—er—I mean, Miss Hockenschmidt. Not Democritus of Abdera, but Leucippus expounded the atomic theory of the Greeks. True, Democritus developed the theory that the universe was an undesigned combination of atoms falling in space, but the original idea came from Leucippus. I suggest you read Bacon's Sixteenth Essay."

Einleill sensed an acute disturbance in the professor. Apparently the man wanted to make love. For some reason not clear to the space creature the man did not make love. Instead he talked about Democritus and Leucippus. Sylvia Hockenschmidt, the dumbest female in the room, was the object of the professor's disturbance. The space creature's appraisal of Miss Hockenschmidt's intellect was not guesswork. The misty being was able to flow through the professor's records.

The infatuation of a philosophy professor, rather young, over a twittery girl, much younger, disturbed Einleill, who had traveled light years across space and who had seen things men did not dream of.

One thing hampered Einleill: man's thinking was too complex to follow. He could observe actions in the brain, but he could not arrive at the illogical solutions that man habitually reached. In lower animals, such as the oyster, thinking was always logical and it could be followed. But the physiochemical processes in man baffled all reason. There were abstractions which were too hard to unravel.

This business of *convention.* It was simple enough to learn the meaning of the abstraction. It was "to do the right thing at the right time." The right thing for Professor Jones to do, for his own peace of mind, was to drag Miss Hockenschmidt home and force her to get his meals. But Einleill gathered that this was the wrong time. What then is the right thing to do at the wrong time? To ignore Miss Hockenschmidt's apparent attractiveness would be the wrong thing to do at the wrong time. It could not be convention or anything else.

"I have always done the right thing, no matter what time it was," thought Einleill. "Therefore, I have been unconventional. In the eyes of man, that is bad."

DISCOURAGED, Einleill drifted through cities and towns observing other men and women. He became more and more discouraged, as he learned that being unconventional was frowned upon. The more Einleill thought, the more static he created. Radio communication was tied up in all parts of the world.

Then he saw a legless man seated on a sidewalk in a city. The man was selling lead pencils. The man smiled.

"Obviously," thought Einleill, "this man is unconventional. It is not the right thing for a legless man to smile. He should be full of despair."

Einleill drifted back to Professor Jones. The sage was sitting at the edge of a bluff overlooking the sea. Beside him sat Miss Hockenschmidt.

"Isn't the ocean beautiful?" said the young woman. She leaned toward the professor so that her golden hair brushed his cheek.

Professor Jones looked at her. "I—I never have seen anything so beautiful!" he murmured.

The creature from space was intensely disturbed. He realized that these creatures had caused his disturbance in outer space. It seemed remarkable that these bipeds could stir up the ether with their emotions.

Rolling himself into a solid mass, Einleill threw his entire being into the body of the professor.

At first the creature from space was not sure that he had done the right thing. Professor Jones behaved as if he had received an electric shock. His thick glasses fell from his nose. Then he moved closer to the young woman.

Through the professor's eyes, Einleill looked at Miss Hockenschmidt. She seemed more beautiful than before.

A look of determination spread over the professor's face. He drew Miss Hockenschmidt into his arms. Almost desperately, he kissed her.

"At last!" gasped the professor. "I realize that Aristotle was right: " 'The end of all action is happiness'!"

Miss Hockenschmidt squealed with alarm. The professor released his bear-hug grip. Then she stared at the man in astonishment. Her lips parted in a smile, showing rows of pearl-white teeth. Jones' heart bounded like a ball. Then it skipped a beat, as her smile widened into a grin. Then she laughed, cruelly. "Oh, professor!" she screamed. "You're funny!"

So fully was Einleill merged with Professor Jones' being that he realized the extent of the man's despair. The world seemed to grow black. Then he felt his ears redden. He felt ridiculous. He was being laughed at. He—he was in an unconventional attitude.

Realizing his attitude, Einleill felt quite at home. Then he pounded at Jones' brain: "It is nothing, my Greek friend. I have been unconventional for ages and thought nothing of it. Is your philosophy so bad that you have no reply for laughter? Why don't you laugh, too. I've watched you make love. After all, you've been about the silliest thing I've seen in a score of universes."

With that Einleill drifted out of the professor.

Jones jumped to his feet. "I've had a revelation!" he cried.

Madly, he seized the girl and bent her over his knee. Then, in the old tradition of school masters, he applied punishment with the palm of his hand.

Miss Hockenschmidt screamed. "Stop! Stop! Oh, professor, I didn't mean it!"

Professor Jones continued with a smile on his lips. "There is the Cyrenaic school of philosophy," he remarked, "which was founded by Aristippus. The school held that the only sound rule of life was to enjoy the present. *Carpe diem.* I beg of you, Miss Hockenschmidt, not to interrupt my enjoyment."

Einleill drifted away from this mad world. "Why should I worry about the curious turns and twists of human philosophy," thought the creature from space. "It is involved, but for a purpose. If man were left alone each individual would find the beating of his heart more important than motions of planets about the Sun. Life is involved, but for a purpose. It is necessary for man to be made to forget that he is man."

Placidly, Einleill lapsed into thoughtlessness.

DAWN-WORLD

Atta Lan—Atlantis—Po-see-da——?

by Raymond Z. Gallun

GORGONE, his name was—Fred Gorgone. His face was as wrinkled, almost, as the faces of the Egyptian mummies, in whose company he had spent so much of his life. His hair was white, like the substance of a prehistoric glacier. His eyes seemed as gray and hard as a stone-age flint; but mellowing their hardness was a friendly twinkle, mild as the sunlighted expanse of the Mediterranean just outside of the Blue Grotto at Capri.

"What are fossils, Joe?" he demanded with fierce eagerness. "What are the ruins of ancient cities? What are fingerprints and footprints, and all the countless other things that show us vaguely what the past, both remote and recent, was like?

"You know the answer, Joe. They are the records of events—of motion, of expended energy—left in the circumstance of matter! They are not like histories written in words, for, since they are the crystallized remnants of the actual happenings themselves, they are perfectly first-hand.

"Each, under simple, visual inspection, tells a dim story. But all substance is extremely complex; it is composed of protons, electrons, atoms, and molecules in staggering numbers. These tiny units of matter must be able to receive and retain detailed impressions of surrounding events—impressions that we cannot see! Science, however, can often go beyond the limits of our senses.

"You're a physicist, Joe. Supposing there was a machine that could unravel the history stamped in the atomic structure of some object? A paleolithic arrowhead, for instance, or the skull of a dinosaur! Even light and sound must influence substance a little, perhaps leaving a permanent trace. If those traces could be reassembled properly, we'd be able to hear the ancient winds blow, and we could actually watch the cave men fight the saber-tooth!"

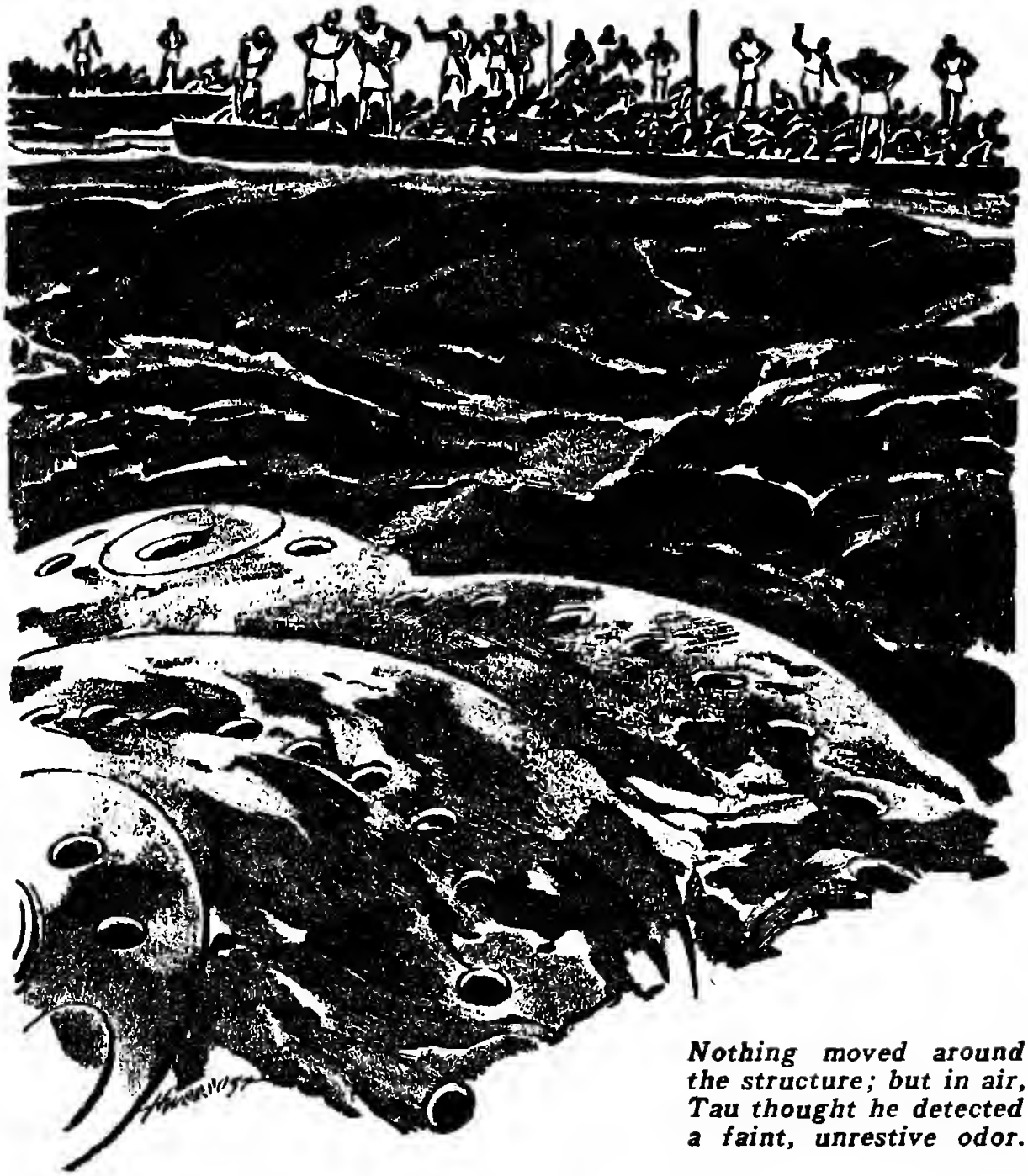
Josef Gaetz didn't laugh at his friend's odd idea. For a moment his round visage was thoughtful in the subdued light of the floor lamp in one corner of Gorgone's study. Then he smiled. "Thanks, Fred," he remarked. "Maybe you've given me a real inspiration."

FIVE YEARS LATER, in Gaetz's darkened laboratory, the dream became fact. While Gorgone looked on, the physicist placed an oval chip of glistening, black obsidian in a crystal box which was part of the marvelously intricate apparatus that he had invented.

The chip of volcanic glass was entirely unworked except for a small hole that had been drilled through its thinnest edge, probably by a man who had lived in paleolithic times, twenty-five or thirty thousand years ago. The object was not a tool; it was an ornament or charm, meant, no doubt, to be supported around the neck of the wearer by means of a thong.

Gaetz twisted dials. There was a faint, crescendoing rustle within the in-

ECHOES



Nothing moved around the structure; but in air, Tau thought he detected a faint, unrestive odor.

vention born of his genius. A glow, soft and golden, enveloped the crystal case. Threads of golden flame, heatless and bizarre, lanced upward from the surface of the prehistoric ornament. Doubtless that flame had roots which, invisible to the eye, groped into the substance of the relic, finding within its myriad atoms the jumbled account of happenings with which it had been involved—happenings lost in the murk of dead æons.

From the lensed muzzle of a strange projector, pictures were thrown on a white screen near by. Color and motion were reproduced perfectly. Sounds

issued from the speaker diaphragm behind the screen. Thus the past lived again.

The first pictures and sounds were incalculably ancient, for the obsidian fragment from which they were drawn had existed not only a long time before some troglodyte had used it as an article of personal adornment. It was, in fact, almost as old as the solid crust of the earth.

For a brief moment there was a winking glimpse of a steaming, lifeless dawn world, revealed in the screen—jagged, uneroded mountains and hills, ghostlike under a great, foggy sun; volcanic ash heaps; scattered scoria and chunks of rock. The sound diaphragm growled in short, staccato bursts, representing the concussions of vast, seismic upheavals.

Gaetz turned the time control of his apparatus, probing more recent, though still tremendously distant, periods of antiquity. There were other glimpses of the developing earth, wrested from the records of matter. But between them were long gaps of darkness and almost complete silence, during which the lump of obsidian had evidently been buried, but erosion and quake occasionally brought it into contact with the open air.

The two men saw the gray oceans and the vast storms of the azoic era. They saw the first polyps, and the first crude seaweed, sprawling on jagged beaches. They beheld Carboniferous jungles, steamy and dark, and weird as something ripped from the mind of a madman. They saw Tyrannosaurus rex, ruler of dinosaurs, battle Brontosaurus, and bring him down in a boggy marsh, gloomy and awful under bright, blurred stars that formed no recognizable constellations.

IT WAS HERE in the heart of the Mesozoic era, that they received their first, clouded hint of a fantastic mystery. In a little forest glade was a conical heap of stones, carefully piled; a cairn. Around it the ground was bare, like the floor of an arena. That was all. The place was deserted and silent, and for what must have been thousands of years afterward, the obsidian shard was deeply covered by the wreckage of a landslide. So, after their first glimpse of the strange encampment or ceremonial place, which was also engulfed, the scientists could learn no more of the latter's secrets.

"There were no men living in times as early as that," Gaetz remarked.

"No," Gorgone agreed.

The vivid portrayal of dawn-world history continued. The savants saw the first tiny mammals; and they glimpsed a bit of their gradual development of brain and body. At last, striding in crouched watchfulness through forest dusk, they beheld a man, or half man. Hairy, he was, with a low, slanting forehead, deep-set, bruitish eyes, and long, muscular, apish arms. Perhaps he was Pithecanthropus erectus. Perhaps he was the slightly more human Eoanthropus.

Ice ages came and went, produced by periodic changes in the form of the earth's orbit, and by variations of the sun's heat. With the final, and perhaps the fourth of these arctic periods, Homo Neanderthal, higher in the scale of evolution than previous subhumans, appeared. After him came the Cro-Magnons, who were really men.

Gaetz and Gorgone glimpsed roving bands of these painted, big-brained, brawny savages on three occasions, before the beginning of a more intimate contact with them. During each of these times, as before, when there had been something especially interesting to view, the physicist ceased turning the time control of his machine, so that the motion of pictorial detail would not be too swift for human eyes to follow.

The obsidian fragment was now ex-

posed, though partly imbedded, in a hillside dotted with coniferous trees. There were clumps of bushes, too, and weeds and daisies in the summer. In the winter there was deep snow in the valley beneath, though the high winds kept the hillsides fairly bare. The climate was cold-temperate, for the slow process of emergence from an age of ice was still in progress. Nevertheless, there were many warm, mellow days of drifting clouds and dappling sunshine.

But peaceful though the scenery was, for the most part, there still were suggestions of menace far more striking than the frequent appearance of herds of vast, shaggy mammoths, bison, and reindeer, or the wanderings of lone cave bears and packs of fierce wolves.

Not even the drums of the savage Cro-Magnons, that made the nights eerie with their heavy, thumping whisper, distant yet penetrating, really told the story of that menace, though there was here what seemed a vague, disturbing approach to the truth. It was the same with the signal fires that gleamed from beyond the opposite hilltops with a red, murky glow, and with the impassioned shouts of warriors, faint because of intervening miles of nocturnal silence.

SOMETHING was wrong somewhere. The physicist and the old archæologist felt the presence of deadly danger even before they saw the speck of flame drifting far up in the darkened sky of a paleolithic midnight. The flame was like a small camp fire; yet camp fires are not built thousands of feet above ground, and they do not float at the whim of the wind. The sight of that flickering point of radiance, insignificant though it seemed, was enough to make the short hairs rise on the scalps of both Gaetz and Gorgone.

They continued their search in silence, not venturing to exchange opinions; for their throats and lips were dry with awe, and opinions seemed pointless at this stage of uncertainty. Gradually, the physicist moved the time dial of his mechanism forward, skipping only days and weeks now, instead of milleniums and millions of years, as he had done before.

Thus was reached the point where the piece of volcanic glass first came to a man's attention, inspired a thought in his great, coarse brain, and provoked action in his muscles, and in his calloused but capable and artistic hands.

He came toiling up the slope of the hill that was pictured in the Gaetz apparatus. His panting breath was plainly audible. He was a magnificent savage, well over six feet tall and broad in proportion. The scientists saw his broad, sparsely bearded face, shaped and painted like an Indian's. Now, apparrently, his eye was caught by the fragment of obsidian, which, from his point of view, must have glinted brightly in the rays of sunset. He stooped, and his hand reached out.

Then the whole scene shifted and wabbled crazily, as he straightened, lifting the fragment of natural glass with him, and then descended the slope back toward the valley floor. But Gaetz and Gorgone saw his delighted grin, provoked, no doubt, by his find. Nevertheless, he uttered certain grumbling words which may have expressed something related to an aching and lifelong resentment.

"Our little relic has found a friend at last," Gorgone commented. "If this McCoy of all Cro-Magnons keeps it in his possession, we'll almost be able to read his thoughts, because then we can observe his every move and expression. Maybe we'll even be able to pick up a bit of his language."

Gaetz was just opening his mouth to reply, when a distant sound burst from the diaphragm behind the screen. Its possible significance was arresting to say the least. Sharp and explosive, it

was not quite as sharp as the report of a rifle, but more like that of a musket. Could there be muskets in the paleolithic?

At once there was a wild wavering of the view in the screen, as the Cro-Magnon scrambled instinctively for cover. But that his fright had not dissolved his courage was evinced by the fact that he did not drop the bright and intriguing bit of volcanic glass that he had picked up. From behind the bole of a large conifer, he took careful observation of the wooded valley. Clutched in one hand he now held a stubby-handled spear with a broad, flint blade, which had been thrust under the thong of his breech clout.

"What the devil!" Gorgone blurted.

But Gaetz held his finger to his lips in a silencing gesture.

II.

TO TARC the Cro-Magnon, tranquillity was not even an ideal. He could not have known that such a state of existence was possible; and had he known, he would have despised it. In the nearness of danger and death, he found something that the habits of his time had made essential to his happiness.

The shock of the distant explosion had startled him; there was no doubt of that. He had felt sudden fear; he had felt hatred; but still there was a paradoxical pleasantness in these emotions, a pleasantness which is the wine of life to all adventurers.

Tarc was cooler now. The report had seemed to come from somewhere far off to his right, away from the hidden dwelling place of his tribe. And no sign of enemies could be seen in the valley before him. Thus, the necessity for immediate action was removed.

It would be well to wait for darkness before attempting to return home. So Tarc threw himself down behind the trunk of the great tree, in the shelter of which he had sought refuge.

His thoughts rambled without special purpose, bringing him, by turns, feelings of superstitious awe, of egotistic pride in the strength of his body, and of intense and almost morbid curiosity. He even sniffed with enjoyment the refreshing smell of pine needles. Tarc's daring and his powerful muscles had made life easy for him. As yet, his mettle had not really been tested. In a way it was fortunate that he could not look ahead a few hours into the tumultuous future.

He knew why all his kind was preparing for war, though he did not completely understand the nature of the gathering clouds. To the southeast, in the deep lowlands, near the great salt lakes, dwelt a wondrous folk whom his people had always dreaded; and those folk were only the favored servants of a race of demons, with powers incredible.

Now, to the southwest, a new danger had developed, which was more devastating in its capacities than the other, though stripped of all mortal cunning. It was elemental and senseless, like a thunderstorm or a blizzard. It did not concern the Cro-Magnons directly, since they were highland dwellers; but it must inevitably lead to the cruel enslavement and death of many thousands of their numbers. The mighty ones, whose stone cities were beside the salt lakes, could be depended upon to do their best to save their empire from destruction.

Tarc knew, too, what sort of device had produced the sharp, explosive sound, and why the cruel bearers of those devices had invaded the highlands. But this sketchy knowledge only served to elevate other, deeper and more marvelous enigmas into his consciousness.

THE SUN set. Night fell, and under its concealment Tarc began his cautious approach to the refuge of his tribe. In his hand was still clutched the bright, obsidian fragment. From it he meant to fashion a protective charm; for behind its opalescent glitter it was easy for him to imagine that guardian devils were concealed, guardian devils whose help he would need in approaching crises, more than ever before.

His way led him along a brambly forest trail. Following it for some distance, he came to a cleft in a high ridge of rocks. A water-cut tunnel, black as Erebus, led downward here.

However, Tarc did not enter the passage at once; for a new sound, the like of which he had never heard before, caused his muscles to quiver with unrestive excitement. It was like the sound made by the throbbing wings of huge, nocturnal moths; only, though very faint, it obviously came from a great distance to the west, and hence, if heard from near by, must be loud indeed.

Tarc's grandmother had once described such a noise. Its significance, she had said. was more terrible than even that of the drifting things that bore fire through the sky; for it was the true mark of the evil demons who ruled the enemy. It was the growl of a flying dragon, which carried those demons wherever they wished to go.

Only for a few seconds was the eerie droning audible. To the west its source had seemed to lay; and there, presently, it faded back into silence.

But Tarc came out of his statuesque stance of listening, with a fresh scar on his soul. His self-assurance was pricked, and he felt inadequate, nervous and uneasy.

Growling to himself, he descended into the thick darkness of the tunnel. Loose pebbles rattled under his feet as he hurried feverishly forward. Even though he could not see, he did not need to grope his way, for he was on familiar ground.

He emerged at last into a kind of natural courtyard—the widened floor of a deep chimney in the rock. Through the opening far above, a few stars were visible in a patch of sky.

However, there was other light here now, afforded by little blazes which arose from moss wicks set in shallow soapstone dishes which contained fat. These crude lamps were ensconced in niches in the walls. From the latter, in the flickering yellow illumination, peered big-eyed bison, mammoths, and other beasts of the age, painted in black and white, orange and brown. An offensive litter of bones and other refuse covered the floor.

THERE WERE caves in the sides of the courtyard, and before the entrance of each, men and women, clad in crudely cured pelts, squatted, busy, for the most part, with the chipping and sharpening of stone weapons. But on Tarc's arrival, all bowed their heads in respect, and in a singsong tone quoted together: "Lo-oo, Tarc! Lo-oo, Tarc!"

Even the naked children, energetic but curiously quiet—for unnecessary noise might bring death or slavery upon the entire tribe—joined in to greet their chieftain.

In return Tarc spoke two names of terrible meaning. "Atta Lan!" he said with soft emphasis. "Po-see-da!" Then, while his wide-eyed, nervous subjects listened, he recounted the details of his recent adventures. His bravado masked the fact that for once he himself was also uneasy.

In the background, a young woman with a babe in her arms, crouched, listening worshipfully. She was Tota, Tarc's wife. But knowing the customs of her people, she did not expect any notice from her lord, now that he was busy with matters that concerned the welfare of the clan.

When Tarc had finished with his story, his subjects took up their work once more. There was a steady *chip, chip, chip* of stone, plied with small fist hammers, and with slender, flaking tools of horn.

Long after his people had crawled into their holes to sleep, the chieftain toiled to prepare his protective charm. A small, cylindrical shaft of wood, tipped with a flake of hard emery, spun between his palms, the point gradually drilling a hole through the thin edge of the refractory fragment of obsidian. When the task was finished, Tarc hung the ornament around his neck by means of a rawhide thong.

Now he arose, and listened momentarily for sounds of danger. But there was nothing to hear other than the muted rustle of the wind in the chimneylike shaft above. Horror might hide behind that dreamy whisper, yet no one could detect its presence.

Next Tarc entered a cave mouth in the wall. Flickers of yellow light from the single lamp which still burned in the courtyard, probed into the shadowy interior, showing dimly the positions of reed baskets, heaped pelts, and piles of dried rushes.

The piles of rushes were sleeping pallets. Moving forward, Tarc peered down into one. Tota was there—Tota and little Kudo. Tota's reddish hair was rumpled like a coppery wave over a pillowing wolf skin, and her features, broad and comely beneath her white forehead, were relaxed like a child's. In sleep, Kudo's chubby face wore a baby frown of seeming concentration.

Tarc was scarcely a sentimentalist, yet something that was like the concerned whine of a big dog trilled deep in his massive chest as he looked down upon the two who, beneath his harsh ways and his adventurous detachment, formed the center of his life.

Perhaps it was the thought of them that directed his attention to a bit of magic, which he deemed specially effective in warding off evil. It was a magic of his own, which he had discovered quite accidentally, while attempting to make new kinds of paint, for the fresco work of his leisure.

From a rock shelf projecting from the smoke-grimed wall of the cave, he took a dried bison bladder, half full of a simple mixture of three ingredients: powdered charcoal, saltpeter from a niter cavern, and sulphur, procured near a hot spring.

Taking a small quantity of the grayish stuff in his fingers, he tossed it on the still-glowing remnants of a fire, in one corner of his habitation. At once there was a hissing flash of red sparks, and a puff of pungent smoke. Tarc muttered a spell, and the ceremony was at an end. The chieftain did not know that if he but placed his discovery in a solid container before igniting it, he would have a giant at his command—a giant widely used in the warfare of future ages.

III.

HE WENT BACK into the natural courtyard, and, clutching his spear, crouched in a corner, on guard. He looked capable in that capacity, with the flame of the lamp emphasizing, in shadow and light, the muscle ridges of his powerful body. But the ways of the Atta Lan were subtle and treacherous beyond any method of defense employed by the Cro-Magnons.

He heard no sound except the sough of the night breeze in the skyward opening. He smelled no warning odor, for though such an odor existed, it was quite like that of the smoky refuge. He did not know when he began to doze unnaturally. His dozing became drugged sleep.

In the silence above there were noises like the chucklings of trolls, sonorous and gleeful. And the things that de-

scended from the opening overhead, on dangling ropes, during the next few moments, were like trolls in many respects, though outwardly they were human. Their faces, though clear-cut and handsome, bore a definitely satanic cast. Their skins were bluish, instead of white, black, or brown. They were the people of a lost legend.

They were clad in short tunics of white fabric, sewn with threads of gold, and there were heavy ornaments of gold about their wrists and ankles. Attached to their belts were knives, and crude firearms of matchlock design. Over their mouths were leathern masks which must have been intended as a protection against the narcotic smoke they had used against the Cro-Magnons. The smoke had been produced by the burning of an extremely potent drug, extracted from certain lowland plants. The retort employed for this purpose was somewhere at the top of the sky opening. It was specially designed for the purpose of stupefying cave dwellers in their lairs.

Tarc was presently aware that his arms were bound firmly behind his back, and that other adults of his tribe were in a similar predicament, around him. But to his drugged mind this knowledge was like the jangled illusions of a horrid dream. He heard moans and whimperings, and he saw the small, brown bodies of children, too young to be useful to the slavers, raised on high by their ankles, and put to the sword.

He was too dazed to be angry until he heard little Kudo's expiring scream. Gasping with insane fury, he tried to rise, but the stock of an Atta Lan matchlock struck the base of his skull. When, a few moments later, he had recovered a trifle from the stunning effect of the blow, he could hardly remember what had happened, for his thoughts were too vague. Tota, his wife, was weeping hysterically, as were other women.

There were twenty Atta Lan, and about a hundred prisoners. With their necks tied to a long rope at intervals of about a yard, the latter were prepared for the exodus. Still drunken and clumsy, they were dragged into the dark tunnel.

Out in the night, the cold air refreshed them and brought realization.

Tarc uttered a low growl of hatred. No, it was more than hatred. It was madness—madness that was as incurable now as that of a cave bear, dying of a festered, maggoty wound. Gone was Tarc's fierce joy of living, burned out of him by grief. Yet the cunning of the beast within him prevented him from making any wild protest. Violent death was a common thing in the primitive world in which he lived; but this fact did not lessen his fiendish lust for vengeance.

Somewhere behind him in the tethered column of captives, Tota was whimpering pitifully. But for the moment there was no compassion in his heart even for her. "Silence, woman!" he hissed savagely, and for a time she was still.

THE NIGHT wore on, and the wretched company of slaves, and their dark-skinned guards, continued with their tedious march. They were headed south, making their way through wooded hill country that sloped gradually toward the lowlands, which was the horror country of every Cro-Magnon tale and legend. There were the cities of the Atta Lan, and there dwelt those cryptic and little-known demons of incredible learning: the Po-see-da.

Occasionally, there were distant, disquieting noises to mingle with the whisper of the wind and the crunching of twigs and pine needles underfoot. Somewhere an aurochs bellowed. A herd of the small wild horses crashed through a thicket. A Cro-Magnon tom-tom awoke to life suddenly, beating a

rustling tattoo of fearful excitement. Then there was a volley of reports from crude matchlocks, followed by silence, ominous and deathly. Another band of primitives had yielded their souls and bodies to superior wisdom.

In spite of these various disturbances, however, the night seemed strangely tranquil. There were no lurid reflections of signal fires. There were no war cries. Cro-Magnon morale had melted before the power of the Atta Lan.

There was nothing for Tarc to do but plod on and think, and try to plan. He did all of these things with the dogged stoicism of the beast. But in his heart, mingled with his black hatreds, was fear; ghastly, aching, superstitious fear, which even a man of the twentieth century, thrust into his position, might have felt.

The lowlands—beautiful, wild, hazy, and warm—but dreadful. Why? First, of course, because of the Atta Lan. Yet, after all, the Atta Lan were human. Behind them were the Po-see-da, whom rumor had said were not human. The Po-see-da were aloof. They kept their own council, revealing only such knowledge as they saw fit, even to their favored people. So, at least, was the story, which, by grapevine telling, had found its way all over paleolithic Europe.

Perhaps, thought Tarc, the truth would soon be revealed to him. Perhaps he would soon see with his own eyes the real texture of the horrid mystery. Off to his right, in the forest, a large, nocturnal bird uttered a raucous cry, its wings thrashing in the foliage. And Tarc, courageous fighter that he was, started as if touched unexpectedly by a hot coal.

After that he fell to testing the cord which fastened his neck to the long rope that tethered all the captives, his fingers fumbling with it gingerly. But an Atta Lan, moving a little behind him and to his left, spied his action, and with sadistic pleasure, struck his shoulders with a thorny branch. Dark blood oozed, revealed by stray dapplings of moonlight which sifted through the forest, now, from the eastern horizon.

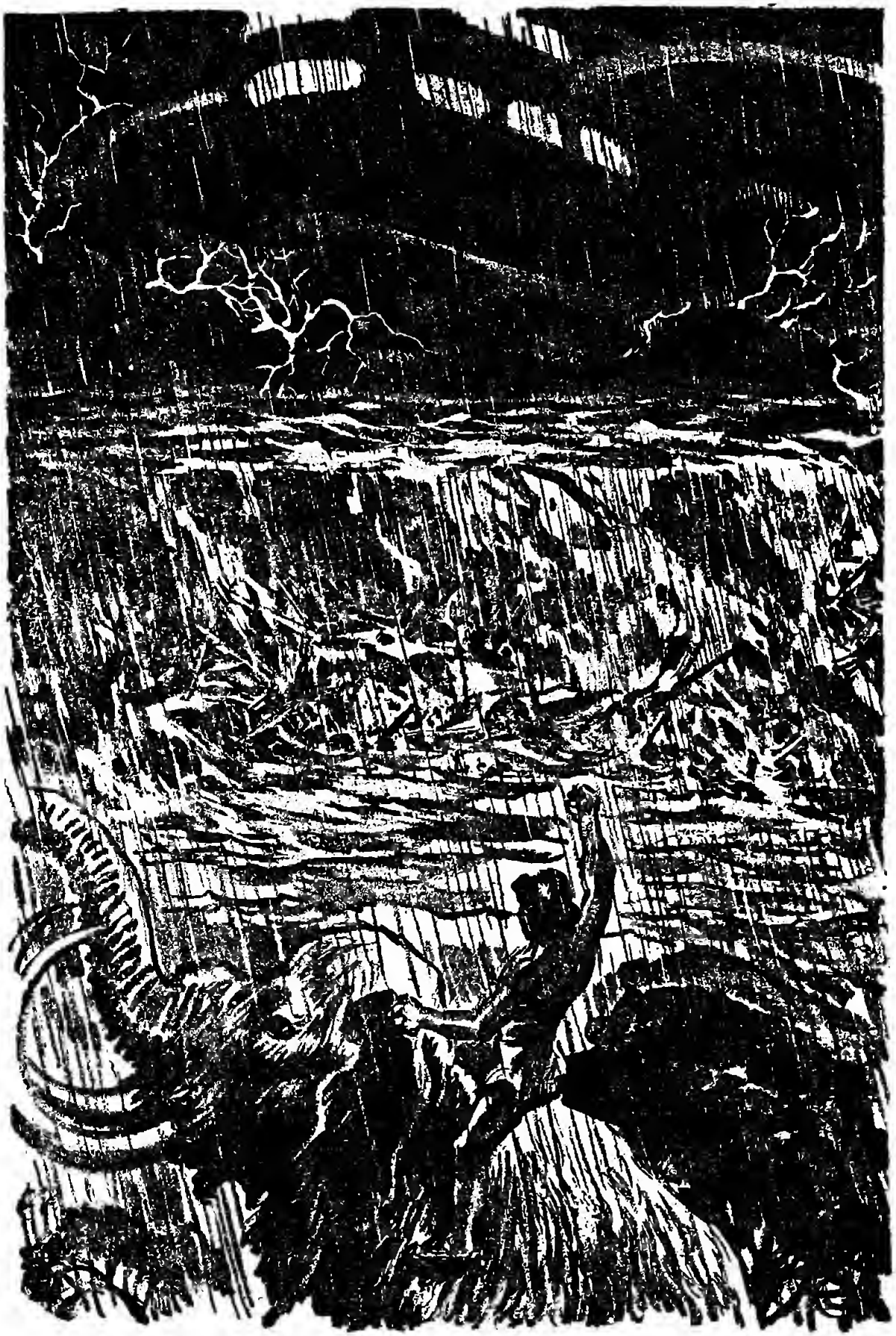
For a second Tarc's bristly jaw hardened, and his narrowed eyes took on a gleam of murder. Then reason conquered. His time was not yet. Maybe a chance would come, later, before the Atta Lan had slaved him to death in that vast, unknown project of theirs, to the southwest. Tarc relapsed again into sullen, reserved docility, beneath which smoldered hell.

The hours of darkness passed without remarkable incident. Twice, babbling streams, racing down toward the great salt lakes of the lowlands, were forded. And once, not so far overhead, a red light drifted. But Tarc had looked upon this strange phenomenon before, and, in consequence, it had lost some of its power to awe him.

Above the light there was a bulbous thing, showing gray and ghostly in the moonlight. The Cro-Magnon chief had never heard of the Archemedes Principle, and he had never seen a balloon at close quarters. But any layman of the twentieth century would have recognized the thing of the drifting light for what it was: a fire balloon, buoyed in its flight because of the lowered density of the heated air within it. The Atta Lan had found a limited use for them as vehicles of experiment and travel.

IV.

WHEN the beautiful dawn, flaming and golden because of the heavy, humid atmosphere of the lowlands, was breaking, the weary party of captives descended a steep slope, at the bottom of which spread out flat, cultivated land, interspersed with groves of trees, and dotted with fortified habitations of gray stone. Here the caravan continued along



Low overhead, beneath the scudding, lightning-creased clouds, a birdlike form, grotesque and mechanical, circled without haste——

a paved road, reaching at last a gigantic, battlemented edifice on the bank of a canal which ran in an east-west direction.

Thousands of other Cro-Magnons were here, brought in by bands of fierce Atta Lan, who had probably been scouring the highlands for days.

With tense, clinical attention, Tarc watched the proceedings. There were vast, flat barges on the canal. The slaves were herded aboard them. Barking commands were given. Thorn branches swung viciously, biting into flesh. The women were driven into pens; the men were divided into groups to ply the immense sweeps which propelled the craft. Somewhere in the turmoil, Tarc lost sight of Tota.

Driven by the sweeps, to which the slaves who worked them were securely chained, the ponderous barges moved westward. Once Tarc attempted to converse with his grim-faced, sweating fellows, but a tall Atta Lan, ever watchful for trickery, administered a swift, silencing blow with a thorny stick.

Shortly after noon the canal boats came to a halt beside a tremendous depression in the ground. Water and food, the latter a thin gruel made of a milletlike grain, was given to the slaves. The white-tuniced guards spent considerable time looking down into the hollow, in attitudes which seemed to express reverence and worship.

Tarc, sprawled on the rough planking, looked too, first only in mild interest. But then his mind captured an awesome thread of the meaning of the thing he beheld. As if startled, he jumped to his feet. Here, within view, he felt sure, was the central pivot of all that was malignant and evil!

At the bottom of the pit was a circular structure perhaps three hundred yards across. To the primitive mind it suggested a colossal turtle; but it was more like the gun turret of a battleship. Its hue was a drab, metallic gray. Its walls and top, though still looking tremendously stout, were deeply pitted and scored, as if by ages of corrosion, perhaps in submerging sea water. Several doors and hatches were visible in the structure's flanks, but all were sealed.

NOTHING moved around the structure; but in the air, warm and still under the bright sun, Tarc thought he detected a faint, unrestive odor, such as he had smelled around hills and kopjes infested with snakes. Snakes, however, could not have constructed this queer, forbidding thing which looked more ancient and weathered, even, than the surrounding hills. Tarc, quaint and naïve though his reasoning often was, was aware of that.

He *could* talk now, if he were careful; for the attention of the worshiping Atta Lan was not now so keenly directed at the slaves.

"Po-see-da?" he questioned the man nearest him, his word a low whisper.

"What else?" the other responded. "Here in this habitation, so I have heard, dwell the entire race, perhaps a thousand in number. Never were there many Po-see-da, though once there were more than now."

"What goes on to the west?" Tarc demanded. "What must we do when we arrive there?"

"We will doubtless find out soon enough," Tarc's fellow captive replied.

Tarc saw that his informer's cheeks were not as brown as they should be, and that his eyes were very big. Probably he was still thinking of the dread nearness of the Po-see-da, as was Tarc himself. But the latter was also concerned with the problems of revenge and escape, though as yet no solution was in sight and the future held little promise.

The Atta Lan ate. Then the barges moved on again, toward the west. Sometime after nightfall, the crews at the sweeps were allowed several hours

of slumber. Then toil began once more, in the flickering, smoky illumination of torches. Ruled by a similar routine, four days went by.

NEAR EVENING, on the fourth day, the barges entered a place that was like a deep gorge, along the bottom of which the canal meandered. Ahead were busy sounds of Titanic engineering operations: clangings, thuddings, shouts, explosions. And over it all was a steady, threatening roar, new to Tarc's experience.

Tired though he was, he still surged more valiantly on the gigantic sweep, as if by so doing he might hasten the moment of revelation, which he sensed was at hand.

The barge that bore him rounded a sharp bend in the canal, and moved beyond the obstructing crags, which seemed to be sullen reminders that man and all his labors were petty indeed.

With eager, narrowed eyes, Tarc stared at the spectacle before him. Though born of an age which we think of always as being primitive and uncivilized, what he looked upon would have thrilled the heart of any modern engineer.

A huge dyke was there—a dyke miles in length, holding back the gray ocean expanse, visible to the west. For the most part, the barrier was of crude construction and doubtful strength, being composed mostly of earth. Its building had begun centuries before, when the threat of climbing waters had first been noticed; and, at odd intervals, it had been repaired, and its height and strength increased.

Now, since it no longer afforded adequate protection, it was being replaced by a colossal, time-defying, sea-defying wall of stone! In the gathering, fire-dotted dusk, thousands of Cro-Magnon slaves were at work. A large number of them, chiefly domestic servants of the Atta Lan recruited for the purpose, must have been busy here for several months, at least.

Tarc could not have grasped, at a glance, all the implications of the tremendous undertaking. He could not have understood the position of the lowlands behind him, relative to the rising level of the western ocean, swollen by the melting of the polar ice caps of the receding glacial age. But comprehension would come to him, inevitably, if gradually.

THAT NIGHT the education of the raw recruits began. They were granted no sleep—only the slight refreshment of a little cold gruel. Then they were put to work, dragging sledges loaded with stone. There were shaggy mammoths, too, for this purpose; but their numbers were insufficient, and though these animals were plentiful in the wild state, still the process of domesticating them was long, tedious, dangerous and doubtful. And so the Cro-Magnons, both men and women, must be beasts of burden.

A half mile east of the wall lay the quarries, and between them and the barrier ran several paved roads, along which the creaking sledges were drawn.

With a hundred or more of his kind, both male and female now, Tarc was chained to the stout, wooden tongue of one of the sledges. Thus his freedom was as limited as before.

Tota was somewhere among the horde of workers, he knew; but he could not find her. This was not remarkable, for the throng must have numbered two hundred thousand at least, perhaps one third of which were Atta Lan. With a savage ache in his heart, he wondered if he would ever see her again.

But as he tugged to pull the great sledge, his curiosity could still respond to the appeal of the witching spectacle around him. Under bright stars, torches and bonfires cast a flickering

illumination over the scene. Levers of wood creaked as gigantic blocks of stone were pried and jockeyed into position at the top of the sea barrier. Thorny sticks whistled through the air, landing on broad backs that glistened with sweat. In the quarries there were sharp explosions of blasting, and puffs of red sparks—the latter more intriguing and less fearful to Tarc than to any of his fellows.

The methods employed in the construction of the dyke were primitive and unscientific, when compared with those familiar in the twentieth century; but progress was being made, nevertheless. Necessity was there—pressing, urgent necessity—and that was enough to stir the Atta Lan to phenomenal heights of achievement.

Three times during that first hellish night, a ponderous, droning sound approached from out of the east, and something which should have been drawn from a future dream, even in the twentieth century, circled in the air above, its grotesque form limned against the paleolithic stars. It was like a great bird, but it was not a bird, for no living thing could have possessed that dull, metallic luster.

Were there Po-see-da aboard the monster? Po-see-da who looked down critically upon the efforts of their devotees? Doubtless. Yet their greater wisdom was not brought into play to help build that which, otherwise, must take years of human effort. But perhaps, in actual fact, the Po-see-da were not vitally concerned. They had lived long before there had been either Cro-Magnons or Atta Lan. They could take care of themselves. Maybe, then, their watching was only the observational part of an experiment.

V.

DAYS PASSED—weeks. Still Tarc slaved, and still he yearned madly for revenge. The sight of men and women dying around him, and of the body strength of others ebbing away under the strain of the life-sapping toil, aroused in his tough, phlegmatic nerves but little feeling of horror. He only resented with a bitter fury the fact that almost all of those who perished belonged to his own race.

He saw Tota but once, and at too great a distance for him to risk speech with her, since he feared she might be punished if he did so. He could scarcely recognize his mate in the wasted, dust-grimed creature who tugged feebly to help draw the sledge to the crew of which she belonged. Her body bore the marks of many beatings, administered, no doubt, to excite her failing energies.

She did not see him at all, and for that he was glad in a way, for he was ashamed of his impotence. Oh, he could have raved and mouthed, and torn at his chains, but to what purpose? The cool cunning, and the savage hope for vengeance, still held out within him. But he knew that Tota was marked for death. At best, she could last only a few days more. He never saw her again.

His knowledge, however, was increasing rapidly. He knew at last exactly what it was that worried his captors; for in spite of the vigilance of the guards, the Cro-Magnons managed to converse a little in the sleeping pens. Some of them, slaves for many years, understood the speech of the Atta Lan, and thus, by unobtrusive listening, had been able to learn much.

During warm ages the lowlands to the east had been flooded with salt water. But when ice ages came, the ocean level had always dropped, because of the vast quantities of moisture tied up in the form of glaciers. During those periods, the lowlands, kept warm by winds from the south, had dried to a large extent, for the outlet to the ocean proper no longer existed. The ground

at the strait was then too high to be passed over by the shrunken hydrosphere.

In consequence, a vast valley was produced, far below the normal level of the outer seas. Into it, with the coming of the latest glacial period, the primitive Atta Lan had drifted, there to submit to the sway and the genetic experiments of the Po-see-da, who, flood or no flood, had made their home there for uncounted æons.

Now, however, the glaciers were all but melted. Unless the oceans could be held in check, the deluge would pour back through the ancient strait, covering the cities of the Atta Lan, destroying most of their numbers, and wiping out all but a dim memory of their civilization.

TARC, too, was now the possessor of much potentially useful local knowledge. He knew the outlay of the encampments and the workings of the project fairly well, for slaves thirsting for freedom are keen observers. He also had part of a scheme—a wild part, which no Cro-Magnon other than himself would have dared to think of putting into effect. This statement is no reflection on the courage of the others of his kind; but they lacked a special fragment of Tarc's experience.

The one thing he lacked was freedom from the eternal vigilance of the matchlock-armed guards, and from the stout anklet and chain, which, always, day and night, limited his movements.

He seldom saw any of the members of the small tribe he had ruled; and the sullen suspicion now within him prevented him from making fresh human contacts. He guarded his thoughts with jealous secrecy.

But then Moob came into his life. Moob was not a man, but a magnificent mammoth, who, like the unskilled slaves, drew sledges back and forth between the ocean wall and the quarries. Moob was a magnificent specimen of his kind, his giant shape tufted with long, reddish-black hair. His curving tusks had never been removed, for frequently his regular task was broken by a few hours of handling scaffold timbers, and here, as with the Indian elephants of a later time, his natural armament was very useful.

Tarc—he was on a day shift now—first saw Moob one afternoon when some Atta Lan whim or purpose caused the mammoth to be transferred to the quarry and road where he was employed. At once Tarc was intrigued. At first this feeling must have been only the attraction an artist experiences for a favorite subject. Often, in the past, Tarc had painted murals of these splendid brutes on the walls of his tribal refuge. Anyway, a vagrant impulse caused the Cro-Magnon chief to hiss softly, as the sledge to the crew of which he belonged passed Moob's sledge on the roadway.

The result of the attracting sound was rather remarkable. In spite of the Atta Lan driver, who crouched on his tufted head, Moob stopped. His little eyes roved this way and that. Then his trunk lifted, and a querulous, questioning grunt, with almost a note of hope in it, gurgled up from somewhere within his mighty carcass. "Are you a friend?" he seemed to say.

Tarc received a beating for his breach of discipline; but at the next opportunity, a few hours later, he gave the mammoth another hiss of salutation. Perhaps it was only a fierce defiance that prompted him to do so; but then, maybe it was something deeper—a yearning that was indefinable.

Again Moob stopped, and this time trumpeted a lusty greeting. Tarc was punished more severely than before, and though, from then on, he made no attempt to call the attention of the mammoth to himself, Moob was still disposed to continue the amicable relations. His

keen sense of smell had already catalogued the scent of his human acquaintance, and always, when it came into his nostrils, he voiced a sonorous bellow. Somehow, the heavy sound made Tarc's blood tingle with a wild surge of nameless ecstasy.

What is the nature of the strange ties of kinship which sometimes spring up, unheralded, between man and beast? Does any one truly know? Does some mysterious telepathic process establish a bond of understanding? Here were two savages, one of them human, the other perhaps almost human in mind, and little short of Gargantua himself in physical strength. Both, though sullenly docile on the surface, must have longed to be free with a longing that was torture.

Can the relationship of Moob and Tarc be explained thus? Maybe, maybe not.

Anyway, for three days the mammoth, regardless of the goadings of his driver, greeted the Cro-Magnon chief lustily at every opportunity. The Atta Lan saw not only inconvenience but possible danger in this habit; and so, inevitably, Tarc was transferred to another sledge crew on a different road.

VI.

LIFE went on as before. Tarc grew thin and gaunt, but his remarkable stamina enabled him to keep his strength.

A month went by, and the work on the ocean wall progressed slowly. Then came the storm from out of the west. It began toward midnight, a howling, screaming holocaust of wind and driving rain.

Tarc was in the sleeping pen occupied by his crew, at the time; but he awoke when the first raindrop struck his flesh. One glance told him what he might expect in a few moments, and his first thought was to seek shelter. None was available, however. The sleeping pens were wooden inclosures, all of them open to the sky. Within them the slaves were chained to long, horizontal rails of wood supported a foot or so off the ground by massive blocks. Thus they could move only in a narrow arc, prescribed by a short length of chain.

Tarc could only cover himself with the reed bedding with which the floor was sprinkled, and watch and wait. Second by second the wind mounted in velocity. Then, with a terrific flare of lightning and a deafening crash of thunder, the deluge from the sky began.

For a few seconds Tarc received the hammering weight of it with his head buried in his arms, the terror of the beast for elemental forces, upon him. But presently curiosity conquered. He raised his eyes and looked out over the encampment, toward the wall. All building operations, conducted by the night shift, had, of course, ceased. Men were scurrying hither and thither, seeking refuge. Great bonfires, pounded by the rain, were dying. Shouts and screams were lost in the yammering of the hurricane.

Above the sea dyke white caps were lashing. Would the barrier hold? Savagely, he hoped that it would not, even though he would perish with the Atta Lan, if it were broken. But no; unless there was a mishap of some kind, it probably would withstand the shock of the storm, since, in the past, it had undoubtedly withstood the shock of other, similar storms.

He waited, wishing that he could find something to snap his chain, as he had often wished before; but the Atta Lan guards still stood in their wooden shelters, cruel eyes watching, matchlocks ready.

Then came the hail, hurtling down like volcanic stones. Stoically he endured the bruising impacts of it, his head covered with his arms. After sev-

eral minutes there were sounds of a commotion near the sleeping pen: squeals, grunts, bellows, and the splintering of wood. Then the sharp roar of matchlocks. The guards in his pen, and in others, were discharging their weapons for some reason.

Tarc looked up, protecting his head against the pounding hail with his upraised arms. Out through the storm, where the checkerboard of the sleeping pens began, he saw a full score of great, gray backs, and ponderous elephantine heads. Mammoths! Mammoths amok, terrified by the hurricane! Madly, their line of flight blocked, they were heaving and thrusting at the outer stockade of the pens.

Now, in spite of the volleys of matchlock balls, which could have done little damage to the great tough-hided beasts, unless very accurately placed, the stockade collapsed, and the monsters rushed in. Slaves, trampled under foot, screamed in wild agony. The lesser, inner barriers of the pens, crumpled like paper before the frightened rush of the Juggernauts, who had broken out of their own quarters.

TARC was on his feet now, heedless of the battering hail and the fierce, tearing wind.

A half dozen Atta Lan guards were waving their empty matchlocks above their heads, shouting futile orders to the maddened Pachyderms. In their flow of jargonic words Tarc caught the name, "Moob!" repeated over and over again. This name, voiced by other Atta Lan on other occasions, was one which he could never forget.

Tarc felt a strange, paradoxically pleasant thrill quickening his pulses. With hunched head and narrowed eyes, he peered through the storm. Hopeful suspicion became ecstatic certainty. Leading the runaways was the colossus of all mammoths. There was no mistaking those great, curving tusks, which only one of these giant draft animals that he had ever seen had been allowed to carry.

For a moment it was impulse and not reason that ruled the Cro-Magnon chief. But even then, at the edge of his consciousness, there must have hovered the ghost of an almost smothered scheme.

His arms were flailing to attract his monstrous friend's attention. "Moob!" he yelled, and the mighty wind tore at his mouth and throat. "Moob!"

The leader of the mammoths stopped, his feet spread wide apart, as if to brace himself against the storm. His ragged ears rose ludicrously as he listened. His long trunk was raised as he tried to sniff, through the bucketing rain and hail.

"Moob!" Tarc shouted again.

It was enough. The Pachydermic memory has become proverbial. Perhaps Moob could scent, even through the tortured air, the odor of his human friend. Or maybe telepathy and keen intuition took a part in what happened next. With a bellow, Moob trotted forward, crashing easily through the wooden sides of the intervening pens. He did not even seem to notice the dozen hapless slaves, both men and women, that he stepped on in his progress.

Thus he reached Tarc's pen. The wooden tether rails to which the slaves were chained, snapped easily when his great blundering feet tripped against them. A sudden tautening of the linked tether fastened to the iron ring which encircled Tarc's left ankle, hurled the chieftain prostrate.

But in the next second he realized that, except for a short piece of chain, loose at the opposite end now, he was free. The rail around which it had been looped was broken in several places, and the loop had slipped from the splintered pieces. Similarly, the other slaves, both

in his pen and in others through which Moob had passed, were at liberty, or would be so in a moment, after they had extricated themselves from the wreckage.

Automatically, Tarc had bounded erect once more. Now he stood, a little dazed, facing the monster who had granted his dearest wish. But primitive minds are swift in thought, and primitive bodies are quick in action.

The herd of runaway mammoths were close on the heels of their leader now. Cro-Magnons were screaming from fright and injury. Moob stood still, sniffing at his chosen master; but a similar docility could not be expected from his fellows. Frightened at the fury of the storm, they might blunder anywhere, with disasterous results.

Again Tarc's hitherto chimerical plan glimmered clear in his brain. It was now or never. The Atta Lan guards in their shelters, were hurrying to reload their matchlocks.

And so Tarc seized Moob's trunk, a gesture which the trained beast understood. At once the chieftain was hoisted to a position atop Moob's head. Doing as he had seen the Atta Lan drivers do, Tarc reached forward, grasping the mammoth's ears, and plying them just as one plies the reins on a horse's bridle. Thus guidance was quite easy.

Directed by his rider, Moob turned about, advanced the way he had come, pushing his fellows before him.

AS NEVER BEFORE, Tarc felt himself a leader of his kind. Buffeted by wind and water and hail, he turned a little on his swaying perch.

"All slaves who can, follow!" he screamed. "We can be free forever! We can have our revenge, if we are brave! Kill the Atta Lan guards, lest they find the means to betray us! Kill the guards, and follow!"

Faintly audible behind him, muffled by the yammering of the storm, were the noises of a brief altercation. Three shots were fired. Then there was only the triumphant voice of the mob, to mingle with the voice of the hurricane. Tarc did not even look back. He was looking ahead, wondering what danger must next be met and surmounted. A few Atta Lan scattered before the horde he commanded. There were several reports from matchlocks, but most of these weapons were too drenched with water to be of any use.

The party, almost two hundred strong, the majority of them men, won clear of the inclosure that surrounded the sleeping pens. Tarc, guiding Moob, whose fellows still hovered in the background, led the way up the slope of a hill.

A cave yawned before him—the magazine where the explosive used for blasting in the quarries was kept. Lithely, he bounded down from Moob's head and advanced. A bullet whizzed in his direction—then another. But six guards, even when armed with matchlocks and knives, were hardly a match for nearly two hundred Cro-Magnons, filled with the lust of murder.

A little torch, carefully protected by a metal grid, burned inside the cave, where many boxes were piled.

"This shall be a holiday for the demons of fire and water," Tarc declared to the horde that crowded about him. "I understand the gray substance which bursts with a loud sound and great force, for I have made it myself, to use as a magic charm. I did not know half of its magic before my capture, but one can learn much from the Atta Lan. The sparks and the smell of their sorcery told me that it was the same as mine, and so I do not fear it. Load yourselves with this stuff that is ill luck to our enemies, and come with me!"

Before leaving, Tarc took the gridded

torch from its sconce in the wall, and wrapped the cloak of a murdered guard around the cylindrical grid, to protect the flame from the storm. He would presently have a grim use for the torch, when the sea barrier had been reached.

Burdened with cases of gunpowder—in that was, of course: a simple mixture of saltpeter, sulphur, and charcoal, such as Tarc had accidentally invented long before his captivity—the mob moved silently down the slope and toward the wall, against which the ocean hammered thunderously. The chieftain, mounted once more on Moob's broad pate, led the way. The storm had abated slightly; but it was still a howling inferno. Fortunately, the boxes which contained the powder, were fairly water-tight.

Tarc knew the weakest point in the gigantic dyke. At the junction of the old, earthen section, with the new rampart of stone, was a place where the barrier was made unsafe by construction work. But a great temporary buttress was in place here as a strengthening element. Under the buttress, which was of wooden beams, and against the dyke at this point, the Cro-Magnons piled their cases of explosive. Before they had finished, scattered shots from Atta Lan shelters began to pour into their midst. But they paid scant attention, until their work was done.

With a rock, Tarc smashed one of the stout boxes at the base of the pile. Then he jerked the covering from the torch he carried and tossed it into the exposed explosive. With a hiss, the latter burst into violent flame, which, in a moment would ignite the other boxes. These, being sealed and firm, would explode with great force.

Except for Moob, who stood stolidly waiting, Tarc was the last to retreat. Once more perched on the head of the mammoth, he guided his mount away at a rapid run.

THE DETONATION was ragged and long, being composed of many lesser detonations; but it did its work. The huge buttress collapsed with slow majesty. The earthen part of the dyke cracked jaggedly to its base. Mingled with the roar of the storm was the vibrant and crescendoing hiss of sea water.

Ribbons of brilliant lightning revealed the spectacle to Tarc, who dared to look back briefly over his shoulder. Soon now—a matter of minutes at best—the battering whitecaps would break through the weakened rampart, that had been the pride of Atta Lan engineering.

Tarc's followers were scattering like scared rabbits. There was no time to think of freeing the Cro-Magnon slaves still chained in the sleeping pens. Atta Lan, too, were racing about wildly, but there was no battling. There was a truce now, between enemies—a truce of fear.

At a lumbering gallop, his best gait, Moob bore Tarc toward the north. They had just reached the near-by highland foothills when the crash came. The barrier had broken. The few red flares that the Atta Lan had kindled hastily, that they might see to attempt futile repairs, winked out suddenly, smothered by the roaring maelstrom of ocean brine.

Tarc laughed in gleeful triumph, as he drove Moob higher into the safe hills. His revenge would now complete itself. The Atta Lan would pay dearly for the lives of Tota and little Kudo. Tarc did not know that he had changed history. He did not know that the great rock, far to the west, looming dimly through the ebbing storm, would one day be called Gibraltar.

Very low overhead, beneath the scudding, lightning-creased clouds, a bird-like form, grotesque and mechanical, circled without haste. At the windows of the craft, illumined by a green glow within the cabin, were several fragile monstrosities, peering down with great, mild orbs. The creatures looked a bit

like the modern conception of future men. But their immense craniums were covered with fine scales instead of hair. They were reptiles, belonging to a species which had begun its march to civilization during the dim Mesozoic, thirty million years before.

Stricken with terror, as the aircraft swooped not a hundred feet above him, Tarc shook his horny fist at the weird demons aboard it.

"Po-see-da!" he screamed, and Moob trumpeted defiance.

But the audience of the primitive pair paid them little heed. Perhaps the Po-see-da felt neither fear nor regret at what had happened. Maybe they were only bystanders, engaged in interested observation from behind the bulwarks of their ancient science.

Now the flying machine turned eastward and sped swiftly away. Above the horizon in that direction, incandescent streaks that were not lightning, appeared suddenly, flashing at irregular intervals. They were the paths of distant rockets—rockets leaving the earth. The Po-see-da were done with the planet that had spawned them. They could have survived the flood, as they had survived other floods in the past; but such was not their choice. Some restless yearning urged them on to new adventure.

For many minutes Tarc and Moob continued their retreat into the highlands. Then, in the gloom, the chieftain's shoulder brushed against the limb of a tree. The latter caught in the piece of rawhide around his neck. The cord snapped, and the obsidian pendant, which he had worn since before the beginning of his captivity, dropped to the ground. Tarc dismounted to search for his treasure, but he could not find it. The bauble had slipped into a deep crevice in the rocks, where it was destined to lay buried in sediment until 1952 A. D.

Tarc was not particularly worried about his loss, however; he felt no special need of protecting charms now. He groped around for pieces of stone with which to break the chain that dangled from the iron ring about his ankle. The ring he'd keep——

VII.

THERE WAS only darkness, now, in the screen of Josef Gaetz's remarkable apparatus. The two savants looked at each other with weary, fevered eyes.

Fred Gorgone was the first to find his voice. "Atta Lan," he said huskily. "Atlantis! What we just saw was the beginning of the mythical continent's destruction, of course. But Atlantis wasn't a continent at all! It was just the exposed bed of the Mediterranean, well below the normal level of the Atlantic. During ice ages there's an isthmus at Gibraltar, not a strait. If Tarc hadn't blasted that dyke——"

"I know!" Gaetz broke in. "We might all be slaves of the Atlanteans to-day, and science would be advanced beyond our dreams. But the Atta Lan are extinct. The survivors of the catastrophe, even with the weapons at their command, couldn't face the raw wilderness. They were already too civilized. And the Po-see-da are gone. I'm a scientist, Fred, but I'm glad for the way things turned out—damned glad!—in spite of the loss to science!"

"So am I!" the old archæologist declared, his voice unsteady with emotion. And then in a calmer tone, "It's strange how legend distorts facts, and yet manages to keep a grain of truth."

"Just what do you mean by that?" Gaetz questioned.

"Po-see-da—Poseidon!" Gorgone responded. "Poseidon is the ancient Greek god of the sea. Remember?"

Galactic Patrol

THE MOST IMPORTANT NEWS OF 1937

Certain milestones of achievement mark the history of science-fiction. Stories which stand out, to be remembered across intervening years, are these milestones. They have proved to be the very pillars on which we build our interest.

Remember "The Skylark"? "Skylark Three"? "The Skylark of Valeron"? Three epics of science-fiction. "The Skylark of Valeron" appeared in ASTOUNDING STORIES in 1934 and since that time we have received innumerable queries as to when the next story by Dr. E. E. Smith, Ph. D., would appear.

Dr. Smith works slowly. He started work in 1934 on a new story, the fifth in his life, and undoubtedly his greatest effort. 1935 passed while he calculated galactic data, studied nebular activities. 1936 passed while he became more deeply involved in mathematical formulas. The spring of 1937 came and with it the first three installments of "Galactic Patrol."

I read them, fascinated. They were great! Early summer came—and the finished script. I have read it—one hundred thousand words of a stupendous effort—the greatest science-fiction serial Dr. E. E. "Skylark" Smith has ever written.

"Galactic Patrol" is now being illustrated. It will begin in the September, 1937, issue of ASTOUNDING.

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That's my big news for this month. I've worked and waited and built solidly these last four years. Now, once again let's surge forward together. Your friends will thank you for mentioning "Galactic Patrol." I will thank you for the new friends you add to ASTOUNDING'S reading circle.

The Editor.

QUICKSILVER,

As the flame impinged upon the arch, it leaped like a living thing in pain——

Blobs of glistening silver—puddles and rivulets of gleaming liquid—expanding—contracting——

UNLIMITED

by HARRY WALTON

PAY ME!" chortled Tom Hampden, from the vicinity of the atmosphere indicator. He pointed to the needle, swung far over the red sector of the dial. "It's low pressure, unbreathable."

Kerry Holm solemnly surrendered to his partner six of their remaining cigarettes.

"Save them," he warned, "to pay me our second bet."

"To the effect that there is, or is not, life on that forsaken atom ahead. Uh-uh. You're going to pay on that one, too. Can you imagine anything evoluting on *that?*"

Holm stared thoughtfully out the forward port. The telescopic glass brought the glossy-black terrain much closer than it really was. Faintly lighted by the distant Sun, the tiny planetoid, too insignificant to merit the attention of regular exploration ships, indeed presented an appearance of sterility that was startling and convincing. Its surface was broken by worn ridges and deep furrows, all rounded like the fire-smoothed edge of a glass beaker. There was no sign of vegetation.

"And yet—I wouldn't swear it's dead," muttered Holm. "Evolution—the driving force of life—is more resourceful than we are. It may be at work here."

"It will be"—Hampden chuckled—"when you and I are chopping into that stuff for the benefit of International Nickel & Mining. But native life—no. This looks like nothing but a chunk of lava, thrown out of some cosmic volcano a few billion years ago—burned out—dead."

Holm settled soberly to the task of landing their little ship. Eventually, he put the keel down with the nicety of a hen settling herself over a nest of eggs, and leaned back from the controls in lazy relaxation.

"You collect the junk. I want to sit here and wonder why I didn't stick to the comfortable swivel chair I had with International, instead of dashing around the system this way."

"Only because you're not half as damned lazy as you pretend to be," repied Hampden cheerfully, gathering their equipment into a great pile in the center of the floor. "Two hundred years ago you'd have been rambling Death Valley and the Sierras, and thinking gold more important than thorium or nickel. You're built that way, and you know it."

HOLM, yawning prodigiously, eyed the space suits indolently. His red-headed companion sensed the high pitch of excitement which Kerry Holm habitually sought to hide under a superficial and exaggerated laziness of manner. It was the older man's reaction to adventure, just as Hampden's was an aggressive, noisy cheerfulness. Both knew that the apparently lifeless globe awaiting them might provide thrills and surprises undreamed of, hazards too horrible to contemplate—or mineral riches which might render them independently wealthy for the rest of their lives.

Hampden struggled into his suit. Holm, still yawning, donned his. With electronic torches and specimen hammers dangling from their belts, they stepped into the air lock. Air hissed out until suits bulged to the strain of internal pressure. Automatically, the outer door clicked open, and both men

stepped out upon the flinty surface of the planetoid. With practice born of long and painful experience, they took cautious, experimental steps, until they had mastered the coördination of muscles necessary to safe movement under the slight gravity of the little world.

Holm led, impatient eagerness now manifest in his stride, in the quick, backward glances at the slower-moving, more-cautious Hampden. From time to time both men paused, knelt to beam off a sample of the glass-hard, ridged surface. They sought eagerly for signs of differentiation, of strata or outcroppings which might prove ore-bearing. Later they would circumnavigate the tiny globe with radi-electroscopes tuned to detect possible deposits of the more radioactive elements. But the present, primitive exploration of the surface was in its own way indispensable.

They had gone half a mile from the ship when Holm's helmet phone buzzed with his partner's voice.

"Great yawning canyons of Saturn's lesser moons! Look what's dropping in on us."

Holm's beam torch went cold in his hand as he straightened. His searching glance found nothing alarming.

"Look down, not up!" snapped Hampden. "That stuff—rolling this way—is closing in."

BLOBS of glistening silver, puddles and rivulets of restless, gleaming liquid, expanding, contracting, elongating as they flowed over the ridged floor of this world—these Holm saw at his very feet, and for a wide radius about them. Gathering as though animated by some united purpose, the focus of their advance was the two Earthmen.

"If it isn't mercury, I'll eat it," muttered Hampden. "But—who ever saw the stuff act like that?"

"Nobody!" snapped Holm. "And that means danger. Back to the ship for us!"

Both retreated slowly. At once the silvery pools converged upon them, more quickly now.

"Run for it. There's one gap we can break through."

They reached that point, a high hillock which the stuff could not surmount, only an instant before the globules closed round about it. But they were through that weird cordon, sprinting for the ship despite the handicap of their bulky suits.

"Suppose that's—your evolution——" panted Hampden.

Holm glanced back. Globules had become flexible spheres rolling without pause over ridge and furrow, adapting themselves to the rough terrain by yielding to obstacles at the point of contact, as does a rubber tire to a stone.

"We'll make it—easy. Edge on them—in speed," grunted Hampden.

"Think so?" responded Holm. "Don't stop—but look."

Hampden glanced back, to see two spheres coalesce, merging into one larger sphere that rolled more swiftly still. Other spheres from either side bore down upon it, merged in their turn. The new monster globe rolled on at terrific speed, silently decreasing the distance between it and the fugitives.

With two hundred feet separating them from the ship, Holm saw the sphere a scant fifty feet behind. His beam torch stabbed a livid ray of heat into the silvery sheathing of the globe. A cavity appeared briefly where the beam impinged, flowed full again as Holm ran on.

Hampden was fumbling for the air-lock mechanism set into the outer hull. Three seconds should see them safely inside the stout little craft. The port swung wide, with agonizing slowness. A tiny tube light sprang into brilliance inside. Never had the barren, metallic

walls of the cubbylike air lock looked more enticing.

Hampden's foot touched the lower rung of the short ladder, and no more. The globe smote them, an engulfing, irresistible tide that lifted them with breath-taking quickness and bore them upon its crest as a flood might a barrel. Flailing about for hand or foothold, Holm felt himself turned end for end, spun about as though by a gigantic multifingered hand, at last prone on his back, cradled in a yielding, silvery substance that walled up to a height of a foot all around.

Beside him, Hampden struggled madly, sobbing in a panic of desperation, as he strove to rise from that glittering, relentless bed.

"Stop it!" ordered Holm sharply. "You'll be worse off—blind—if you turn over."

HIS matter-of-fact tone brought Hampden to himself. He lay still, every impulse in rebellion against submission. A sensation of irregular, dulled shocks came to them.

"We're moving," said Holm. "Feel it?"

Hampden did not answer.

"Tom! Are you all right?"

Hampden's laugh was a brittle explosion.

"All right? Oh, yes. We're both all right, but we don't know for how long. It all depends on—my Lord!—on a blob of quicksilver!"

Holm kept silent, struggling with the contagion of panic. He forced himself to take account of externals, of the dull, cushioned shock of their passage over that rough terrain, of the still, heavily breathing form of Tom Hampden beside him. The only sounds in all the universe were the magnified beat of his own heart and the loud respirations of Hampden, transmitted through their helmet phones. Without those familiar, mundane noises, he felt they would have gone mad.

Only toward the gray heavens was sight unhampered. The Sun, far smaller than as seen from Earth, glowed coppery red. Far to one side a pale-salmon tint overspread the sky. Their movement was toward it, and its growth swift.

It was not Sunlight. Rather, it resembled the aurora borealis of Earth. It spanned the sky now, salmon glow deepening, devouring the heavens to feed its crimson self, a curtain of translucent fire, intershot with pale lightnings, trembling candelabra of flame.

Holm, forced to stare upward, muttered aloud.

"An unbreathable atmosphere—largely mercury vapor. There would be, with the free metal about, as we saw it. And somewhere currents are generated, ionize the vapor and cause that glow—like a gigantic mercury-vapor lamp."

The calm, matter-of-fact words had the effect intended.

"I owe you those cigarettes," remarked Hampden. "But I have a hunch we'll have to change our ideas about evolution, all the same."

"Change away. I have an idea we'll both be surprised."

They were suddenly aware that movement had ceased. Staring upward into the flaming heavens, they knew the eerie prickle of fear, as support melted slowly away beneath them. Mobile metal flowed from beneath their legs, gathered itself under their shoulders, forcing them into an upright position.

Standing again on their own rather shaky legs, the same black rock underfoot, they instinctively looked about for signs of life. The same barrenness was apparent. Nothing grew from that lavalike ground; nothing moved. Desolation stretched to the amazingly close

horizon of this tiny world, and met the cold, gray sky. But overhead that fiery rainbow dipped to opposite points of the compass, an encircling ribbon of flame. And at their feet, overlooked in their first glance, glittered the nearest pool.

It was an oval of gleaming liquid, still with a heavy stillness of its own, yet sparkling and restless in its reflection of coruscating light from above. To the right and the left identical pools, an endless succession of silvery links flung across dead blackness, like a jeweled chain on dark velvet, stretching from horizon to horizon and paralleling that crimson girdle in the heavens.

Singly, the pools were perhaps ten feet long and four across. Each was joined to its neighbors by arches of gleaming metal that pulsed and rippled as though gigantic, invisible forces flowed within.

FOR MINUTES the two of them stood, motionless as the pools themselves, forgetful even of themselves. What was this thing, what its purpose and who its builders? And why had they been brought to behold it?

Or had they? Holm wondered, suddenly, whether they had been brought for *it* to behold. He awoke to the intense conviction that they were being stared at in turn.

Behind them, the metal globe stood rigid, as though at attention. Beyond it was nothing. Before them was the chain.

It was the chain that was staring. Those pools of gleaming liquid, like a thousand curious eyes, were focused upon them. Not visually perhaps, but with abiding, tangible curiosity. Holm felt it—inquiry emanating from the mirrorlike depths, undeniably real.

"You feel it—asking?" muttered Hampden.

"I do. A questioning intelligence, whatever its physical nature may be."

They bent over the nearest pool. Baffling in its clear, metallic reflection of the flaming sky, of themselves, curiously reduced in size, it told them nothing.

"Mercury again," said Holm. "But not all of it. There's clear liquid on top, and a layer of the metal beneath. And that connecting arch goes all the way down to contact it."

He climbed slowly toward one end of the pool, where the silvery arch bridged the intervening neck of basalt to the adjoining pool without touching anywhere, unsupported and grounded only beneath the shimmering liquid of either pool. Again the unruffled, lustrous surface of the arch seemed to him alive with surging power, as though tremendous energies flowed within.

"I'll bet this is mercury, too," he told Hampden. "Like the rolling globes and the big one, it seems to have variable surface tension. It's mastered that, somehow, and won the power of movement. Here it holds itself rigid. But I'm going to make sure."

He thrust a gloved hand forward. Immediately, the arch wavered, then bent far aside, out of his reach. A bristling crescent of sparks struck out from it, warningly.

Holm retreated. At once the arch resumed its former place, motionless as ever.

Hampden, scowling behind his helmet glass, deliberately sought a projecting bit of rock and sat down upon it. "All right, dope it out. But when you get around to it, remember we have a ship—somewhere—to get us off this crazy space apple. *If* we can get by Adolph, here." He nodded at the watchful sphere, the silent, eyeless bulk of which stood like a sentry behind them.

"We've got to," murmured Holm. "Just now it's content to wait—puzzled, like ourselves. But later——"

He sat down beside Hampden.

"I CAN'T HELP theorizing, naturally. It's another chapter of the old

story—life struggling to *be,* to overcome the dead inertia of matter. In 1936 it was suggested that consciousness, life, corresponded to an electrical current flowing from nerves to the brain, that the potential of that current indicated the vitality or life force; that if the potential dropped sufficiently, death resulted.

"Mind you, we can't say that life *is* that current. For all we know the current simply indicates life. The fact that life is found all through the solar system, in some form or other, argues that it may be of a different nature altogether than the manifestations we take account of. The very fact that it finds expression under widely varying conditions, adapting itself to them, urges that life itself is master of circumstances, not the victim of them.

"Consider this globe; rocks, then metals, finally water, condensing out of its gaseous birth stuff—most of it this glassy lava, unfriendly to organic life as we know it. And yet it is of such nature as to allow mercury, after it had condensed, to remain practically pure, instead of combining as it did on Earth.

"Acids were formed either by electrical storms or by the absorption of gases. Imagine that acid contacting deposits of metal, eventually, somewhere, establishing a crude galvanic cell—a life potential, in embryo, mind you—perhaps thousands of such cells, helpless as tadpoles and less intelligent, but curiously adapted to this world.

Mercury could flow under the tide pull of other cosmic bodies, shift with the shifting of this world's crust as it cooled, run along furrows until it connected two, ten, a hundred of those primitive cells. The marvel is that it happened. It probably took ages to do it, connecting cell after cell, building up potential as you do when you connect batteries in series. It must have been ages while that feeble intellect took stock of itself, learned how to overcome its limitations. How, for example, to control the surface tension of mercury. Electrically, no doubt, although we can't do it yet. And then it acquired mobility."

He nodded at the huge sphere.

"Adolph?" asked Hampden scornfully. "Yeah? I suppose they just shoot it full of juice, and it rolls?"

"Why not? Remember your high-school physics? You had a bar magnet standing upright; at the top of it a stiff bit of wire was hung so that it could swing around the magnet. The bottom end of it hung in a trough of mercury, just to provide a frictionless, electrical contact. You sent a current through the wire, and the thing swung around the magnet, powered by the interaction of the magnetic field and the field that surrounds any conductor of current."

"Got it. The planetoid provides the magnetic field. The pools broadcast their power, controlled to suit. The current ducks through Adolph here, into the ground. Adolph is the conductor, and Adolph moves. But how the devil could he chase us, or even know where we were?"

"Nothing so mysterious about that. We stick up from the ground here, electrically speaking, like a couple of sore thumbs. Ever heard of the old radio sets that squealed in agony when anybody walked too near them, or waved a hand over them? Business of electrical capacity. This thing's senses are probably electrical—which gives them a much wider range than ours have. Although that may be just a wild guess."

"And you've made Adolph wild," shouted Hampden. "Look out!"

Holm whirled to see. The great sphere had come alive. Inexorably, it rolled toward them, forcing them toward the glittering, miniature lakes.

"It's dangerous," snapped Holm. "Tired of wondering. Wants to sample us, dissolve us in its electrolyte."

DOUBTFULLY, they retreated before the monster globe. Like some relentless engine, it pushed on, always driving them nearer the brink of the closest pool.

"Got to separate," shouted Hampden, his voice panic-edged. "That's our only chance."

"Right," answered Holm, shoving his heat beam back into his belt. Hampden raced away over the furrowed ground, stumbling in his furious haste, and Holm took off in the opposite direction. When he dared look back, he saw the sphere in full pursuit of Hampden.

The latter skirted the chain of pools for a distance, then plunged off at an angle, with the globe in pursuit. He resorted at last to the long, dangerous jumps possible by reason of the planetoid's slight gravity, risking the consequences of a fall.

Holm stopped. With the sphere gone, the pools must be helpless. It came to him, also, that Hampden could never save himself, that there was only one way to combat the chain. But now that desperate race held him spellbound. The globe was gaining, and then Hampden tripped on the rough ground. Immediately, the gleaming ball swept down upon him, hurled him aloft like some grotesque insect, paused, and reversed its travel. It moved now toward the pools.

"Got me!" screamed the phones in Holm's helmet. "I can't—do anything."

"I'm free," answered Holm. "I'll find a way——"

Fear tightened icily about him as he saw that the sphere's path would take Hampden to the chain long before he could interfere—if indeed he could interfere. The thing was rolling at a tremendous rate. It would stop at the brink of a pool, cast Hampden into the gleaming liquid, and hasten after him next. The liquid in the pools might well be deadly—possibly corrosive sublimate, or worse.

"Got it!" shouted Holm encouragingly. "If there's one thing it's scared of, it's a short circuit. And with an atmosphere of mercury vapor here, a short circuit it shall be."

He had whipped out his heat torch. Sprawling on the ground, he sighted along the slender barrel of it for the nearest connecting arch. Propped into a notch formed by converging ridges, the torch lay securely cradled. He rose hastily, gingerly reached out and flipped the switch.

A STABBING PENCIL of flame impinged upon the arch. At once inferno was unleashed. The arch leaped like a living thing in pain, all but collapsed, then leaped again, as though to escape that wounding, probing beam of heat. Along the beam itself raced a flame of blue-white fire, a crackling serpent of self-destructive power. The salmon glow of the sky darkened to saffron, but that gigantic discharge spread a ghastly green-blue illumination of its own.

Holm, at a safe distance from that huge arc, sought out Hampden and the globe. With horror, he saw that they were within ten feet of the chain. Then, as he watched, the globe disintegrated into a thousand glittering beads, precipitating Hampden to the ground. He rolled dangerously near the pools, lunged awkwardly to his feet, and ran toward Holm.

The latter, assured of Hampden's safety, stood watching the havoc which he had caused. The liquid of the pools heaved and bubbled, emitting puffs of steamy vapor. Miniature lightnings flashed from arch to arch. The saffron heavens were turned black as thunderclouds, but beneath there was no lack of light. Pools gave back murkily the green-hued glow. Hampden's face beneath the helmet was mottled and ghastly with it.

"What's happened? I thought I was —gone."

Holm could not answer. Hampden, seeing the heat torch, understood. Both stood then, silenced by the spectacle of death. For that this fierce dissipation of energy was death, they felt with utter conviction. The chain, whose life blood flowed away over that crackling beam, was dying. They knew it as they had known its appraisal. They felt its fear of death, so like their own.

"It—it was its life against ours," muttered Hampden.

Holm nodded wordlessly. Hampden's gloved hands clenched and opened.

"It's—it's horrible, all the same."

"The slow labor of centuries, dying here," said Holm. "It's the end of a civilization—for that chain *is* civilization as this world knows it."

His eyes met Hampden's, read his own thoughts therein. "Glad you feel that way," said Holm. "I only hope it'll help—now. For Heaven's sake, watch out if the beam swings this way."

He approached the beam torch, a solid, chunky cylinder, glowing red. Its insulating handle had burned off, but the heat-resistant heart of it functioned as well as ever, ionizing the mercury-laden atmosphere and thus creating a path of low resistance, or short circuit, for the current of the pools.

From as near as he dared approach, Holm swung his specimen hammer, threw it at the torch. It struck fairly, knocked the torch from its supporting notch. The heat pencil arced wildly about, missed Holm by an inch, and burned fiercely and harmlessly into the sky.

As though a monster switch had been opened, the giant arc flared once and was gone. Its passing left a breathless stillness—a stillness that was not mere lack of sound, but exhaustion. The violent bubbling of the pools subsided. The silvery arches, neither as rigid nor as uniform in size as before, became again almost motionless. The chain, through its scores of pools, seemed to pant with renewing life.

THE MEN turned away, leaving the heat torch to exhaust itself, as it must within an hour. Trudging thoughtfully over the rough terrain, neither spoke until the chain had disappeared behind the horizon, and then it was only in terse phrases, to discuss the most probable location of the ship.

Forty minutes of walking brought them to it, to the very port from which the globe had snatched them long æons ago.

Later, as, in the familiar cabin, they struggled out of their space suits, Holm spoke. "There's a pretty penny of mercury out there. Something International Nickel would like to get its fist on. Of course, you can't expect a soulless corporation like that to exercise the finer sentiments——"

"—like a couple of star-struck prospectors," finished Hampden. "No, International would land its mining ships here and wipe it up within a week, and mercury would drop a little on the market and you and I would get a neat bonus each and this dinky space apple would really be dead——"

"So that it's just as well," said Holm firmly, "that we're going to forget to take bearings when we take off——"

"And, of course," added Hampden, "without bearings, there's no use in making a report at all."

Together, they watched from the port as the ship lifted from the black basalt. Holm leveled off, flew parallel to the surface until a band of crimson bisected the cold, gray heavens, a scarlet ribbon that had been black with death a scant hour ago. Holm swung the ship broadside to it. Beneath them the chain glittered.

And an instant later their tiny ship swung upward and drove furiously for the dark, star-strewn sky of space.

SEEKER of

Life is illogical; earthquakes are illogical time travel——?

by Eric Frank Russell and Leslie T. Johnson

THE Venusian city of Kar shimmered beneath an inverted bowl of blue glory. It was a perfect day for a civic demonstration such as the welcoming home of the first expedition to Earth in many centuries. Citizens appreciated the coöperation of the weather; Liberty Square was packed with a murmuring, multicolored concourse that swirled in kaleidoscopic patterns. Something shrieked in the vault of space; the kaleidoscope turned uniformly pink, as five hundred thousand faces lifted to the sky.

High in the stratosphere appeared a pair of metallic pencils, their rear ends vomiting crimson flames. Sound waves from the rocket tubes fleeted downward, bounced from the eardrums of the expectant crowd. The pencils swelled; the crimson spread along their under surfaces as the retarding rockets belched with maximum power. In a short time the objects had resolved themselves into long, streamlined space ships.

With startling suddenness they loomed hugely to the view, sinking behind the mighty mass of university building. They seemed to pause for a moment, while the great, circular ports in their sides stared over the edge of the roof at the mob beneath. Then they were gone. Came one tremendous, reverberating crash succeeded by a moment's perfect silence. The great audience found tongues, broke into a babble of sound, as, with one accord, it stretched itself into a stream of individuals rushing along University Avenue toward the Kar Airport.

The landing field of Kar Airport presented a scene of utmost confusion. To one side lay the space ships surrounded by a shouting, struggling mob. The uproar was loudest at a point where the overwhelmed City Guards had reformed themselves into a wedge and were desperately battling their way through the barrier of bodies.

Babbling and bawling arose into a crescendo, when it was perceived that the nearer space ship was opening its bow door. Steadily, the circular piece of metal revolved along its worm, retreating more and more into the shadow. A final half revolution and it was drawn into the interior of the ship, while the form of a man appeared in the gap thus left.

The crowd bellowed itself red in the face: "Urnas Karin! Urnas Karin!"

Karin acknowledged the shouts and raised his hand for silence. Half the crowd hissed for silence, while the other half continued to bawl. The hissers reproved the bawlers and the bawlers answered back. Somebody pushed somebody and somebody else resented it. A woman fainted, collapsed, and a little man ten yards away was struck on the cranium by way of retaliation. In a flash, fifty different in-

TO-MORROW

Even as he spoke, the mirrored disk came to life with startling suddenness——

dividuals assumed fifty different versions of what they regarded as a menacing pose. A hidden dog yelped, as somebody trod on it, and from the back of the crowd a piercing voice shrilled, "Woopsey! Woopsey!"

Immediately, the crowd laughed; an ugly situation passed away and silence fell.

KARIN jumped to the ground, followed by twenty of his companions from

inside the ship. A small platform, about twice man-height, stood near. Karin mounted and let his sharp eyes pass over the waiting audience. A uniformed guard placed before him a small ebony box mounted on a tripod. He waved away the guard, stood before the box and spoke.

"My friends," he said, his voice pleasantly magnified by the disseminator he was using, "your marvelous welcome is a reward in itself. I thank you; and again, on behalf of my colleagues, I thank you! Now, I am sure that you are all fairly bursting to know whether this expedition has made any startling discoveries upon our Mother Planet." He paused and smiled, as the crowd signified with a roar that it *was* fairly bursting.

"Well, I am afraid that our story is far too long to narrate in detail. Let it suffice if I tell you that we did not find a trace of the civilization of those who were our ancestors. The great cities, the mighty machines that once were theirs have crumbled into the dust and have been obliterated completely by the foot of Time. Old Mother Earth is airless, waterless and lifeless, thoroughly and completely.

"But we did make one most remarkable discovery." He hesitated for a tantalizing minute. "We found the body of a prehistoric man! It was truly an amazing discovery. There, upon a world so ancient that every artificial mark had been smoothed away, atmosphere had leaked off into space, and even axial rotation had ceased, lay the body of this man.

"Examination of the corpse disclosed the seemingly impossible fact that life had departed from it not more than fifty hours previously. Fortunately, we had with us, as part of our standard first-aid equipment, a normality chamber. We placed the corpse therein, warmed it, liquefied the blood and have succeeded in bringing it safely home in a condition that gives us good cause to hope that the experts in our Institute of Medicine and Surgery will be able to resuscitate it.

"The body of this man is in perfect condition. The cause of death, literally, was lack of breath. He appears to belong to a period placed several thousands of years before our ancestors departed from the dying Earth and settled here on Venus, a period so far back in time that our history reels do not talk of it. Why, his head is covered with hair and he even has hairs upon his chest and legs!

"The ability of scientists, in this our most progressive time, to revive the dead in cases where death is not due to old age and is not accompanied by serious injury is a marvel too well-known to need emphasis by me. Possibly there are some people here who would not be with us but for the miracles performed by our most able men and women." He was interrupted by several cries of assent.

"I feel that there is a most excellent chance of the institute bringing this man back to life and permitting him to tell us his story with his own lips. If my hopes prove to be justified, I intend to make an official request to Orca Sanla, chairman of the stereo-vision committee, that this lone inhabitant of a long-dead planet be allowed to stand before the screen at Kar Stereo Station and give to our world an explanation of circumstances which, to be quite candid with you, we regard as absolutely inexplicable." Karin turned and gestured toward a burly individual standing in the front rank of his scores of followers.

"In any case, you will receive entertainment to-night. Olaf Morga, aided by his brother Reca, who is on our companion ship, has made a complete pictorial record of our venture from the time we departed from Kar to the time we left Earth. The record is being

dispatched to the K. S. Station and will be radiated from sunset this evening."

Karin started to descend, as a storm of cheering broke out. A woman in the center of the crowd screamed "Belt!"

The word was caught up by a thousand others; ere Karin had placed his foot upon the topmost step the whole mob was roaring, "The belt! We want the belt!"

Morga and Karin exchanged smiles. The latter returned to the center of the platform, slowly and deliberately unbuckling the flexible metal belt encircling his middle. He held it loosely by one end, while the crowd danced with excitement.

Suddenly, he whirled it above his head, flung it upward and out. It snaked through the air toward where the throng clustered thickest. Half a hundred men leaped for it as it fell. Then it vanished beneath a mass of human beings all fighting madly for the prized souvenir.

Quick to profit by the diversion, the city guards cleared a path from the rocket ships to the control tower. Karin and his crew, together with the crew of the sister ship, sped along the path, entered the tower. The crowd swarmed out of the airport field, poured in a colorful torrent down University Avenue and put a test load on the moving roadways to the suburbs.

Dusk fell over Venus. The stars set in a Moonless sky penetrated the thick veil of atmosphere just sufficiently to paint faint glimmers of steely brightness upon the sides of two voyagers of interplanetary space. Side by side, in a littered field, the rocket ships slept.

II.

TWO MONTHS LATER, Bern Hedan, the man who got the buckle of the belt, fiddled with the controls of his stereo set and cursed. The brand-new pan-selenite screen of the set displayed, in natural colors and with stereoscopic effect, the final stage of transformation of a sample of Venusian pond life. A hidden announcer betrayed the fact that Sanla's myrmidons regarded a dirge played upon an asthmatic oboe as fit accompaniment to the tri-monthly acrobatics of a frog-faced fish.

"By the death of Terra!" he ejaculated, using the most fearful oath his imagination could conceive at the moment. "I pay fifty-five yogs down and twelve more every high tide to be the owner of the set. I pay exorbitant bills for power to operate it; I produce eighteen yogs per annum for the right to make use of that which I have purchased—or am purchasing." He gestured to nothing in particular and talked aloud. He was very fond of talking to himself.

Common-sense views appealed to him. "And what do we get for this outrageous expenditure? What do we get, I say? Pictorial demonstrations of the domestic habits of red-hammed Venusian baboons accompanied by the noise of wailing catgut. Or the amatory adventures of a deep-sea worm who pays court to somebody's symphony for ten harmonicas. Bah!"

He wound savagely at the coördinating handle protruding from the front of the stereo cabinet. The screen dimmed, clouded over, then cleared and depicted a new scene. It was an interior view of the Hall of Debate in the city of Newlondon. Two men were seated upon chairs placed on a semicircular stage, facing a great auditorium packed with people from floor to ceiling. A third individual stood upon the stage facing a stereo screen. Bern Hedan noticed that a mirror suspended on the wall at the rear of this stage was responsible for the peculiar effect of showing the transmission screen in his own screen, giving him a double image of the three people on the stage.

The stereo announcer was saying;

"This evening you have heard and seen an extremely interesting and most instructive debate upon the subject of another Great Migration. You all know the reasons why the human race was compelled to make use of its discovery of the means of traveling through cosmic space by indulging in a wholesale move to our present abode—Venus. The symptoms of planetary senile decay, such as loss of atmosphere, loss of orbital velocity and speed of axial rotation, became so alarming that eventually it was obvious that Earth's characteristics were altering faster than humanity could accommodate itself to the change. Earth's days were numbered—from the human viewpoint, at least. Venus was a suitable habitat for our forefathers, ourselves and our children's children, and the means to get to Venus were at hand.

"The question that has been discussed to-night has been, to put it briefly: 'Will history repeat itself?' In the course of time, somewhere in the distant future, our planet's fate will duplicate that of Earth. We may not like to think of it, but it is a fact, a perfectly natural fact, an inevitable one. Will Venusians die with Venus, or shall there be another Great Migration?" He signed with his hand to the man seated on his right-hand side.

"The pessimist thinks we are doomed for the reasons he has given you, the most unanswerable of which is that the next foothold in space is the planet Mercury—and Mercury is quite uninhabitable by human beings." He signed to the opposite side. "The optimist believes that humanity shall never disappear from creation, mainly because of our steady scientific advancement which, he has said, will enable us to perfect the art of space travel to such a degree that we shall have the choice of a dozen worlds long before our present one has grown uncomfortable.

"This concludes the debate between Leet Horis of Kar and Reca Morga of the Newlondon Debating Society." He stood staring into the transmission screen while the auditorium thundered with applause.

"NOW we come to the event to which all Venus has been looking forward with the keenest anticipation. Since the Kar Institute successfully resuscitated the prehistoric man two months ago, the entire world has been waiting to hear his story. There has been some comment about this delay of two months, which I am now to tell you was due to the fact that the revival of this man was not, in itself, enough to justify his immediate appearance. He needed a period of convalescence, during which he has learned how to speak our language. You will find that he can speak with fair fluency, the reason for this being that his own language proved to be the root of ours."

Bern Hedan adjusted the clarity knob of his set, making the screen depict the stage more sharply. He moved an easy-chair before the stereo, sat in it and switched on the automatic head-scratcher. Soothed by the restfulness of the cushions and the gentle rubs and tickles of the scratcher, he prepared to listen with tolerance.

Seen in the screen, the pair of debaters left the stage. The announcer walked to the rear, opened a door and, with a dramatic air, ushered in the prehistoric man. The man stood directly in front of the screen and studied twelve thousand Venusians. Two hundred million Venusians studied the man.

The Venusians felt slightly disappointed. The object of their examination did not look as though he lived in trees and ate nuts. His head was covered with disgusting hair, but otherwise he looked quite normal. He stood six feet in height; his eyes were dark, alert, his face intellectual even by Venusian standards of judgment. A

woven *silvoid karossa* hung from his shoulders; the inevitable Venusian belt encircled his middle. He seemed to be quite at ease; it was evident that he did not agree with his audience in giving his own personality a purely antiquarian value.

"It is my privilege," said the announcer, "to introduce to you Glyn Weston, the man from A. D. 2007—a date placed approximately seventy thousand years before the Great Migration, about one hundred and fifty thousand years from to-day." Murmurs of surprise rippled around the serried rows of seats.

"Glyn Weston has told his story to the university board at Kar; he has made a most valuable contribution to the pages of ancient history. I shall now request him to repeat his narrative, and I think that after you have heard what he has to say you will agree that this voice from the past has recounted the most amazing tale ever to be projected over the stereo. *Glyn Weston!*"

III.

MY FRIENDS, began Weston, speaking in a pleasantly modulated voice, there is one thing I must say before I tell you my story. God's greatest gift to man is life. I cannot say that you have given me life, but to the remarkable abilities of your wonderful civilization I owe the restoration of that which was snatched from me—*life!* The poor and faulty power of speech is quite inadequate to convey to you the gratitude I feel. I want every one of you to know how deeply I appreciate what has been done for me by Venusian science.

(A roar of applause shook the auditorium. The audience decided that it was to listen to a man and not to a savage.)

As you have been informed, my name is Glyn Weston. My age I do not know; the reason will become apparent later in my story. In the period that is called mine, if any particular period can be so called, I was a physicist.

My work commenced at the age of twenty-eight, when I was fortunate enough to inherit a very large sum of money. I was then assistant to the famous Professor Vanderveen, astrophysicist at the Glasgow Observatory. For many years my hobby had been the study of the work of McAndrew, popularly called "The Death-ray Man."

McAndrew was a scientist of the previous decade. His life's work had advanced that of certain mathematicians and physicists of the twentieth century, most particularly Einstein, Graham, Forrest and Schweil. He was the world's most authoritative exponent of the space-time concept and, like many other geniuses, he died discredited by his contemporaries because he had asserted that it would be found possible to travel in time, to move through time into the future.

Schweil, with whom McAndrew had been coworker, had shown that time was not an independent concept but an aspect of motion. There could be no time without motion—no motion without time.

This may seem rather obscure to some of you, but it really is quite simple. Try to imagine time without motion; consider the means whereby you estimate time. The two cannot be separated, for they are merely different aspects of the same thing. McAndrew's life was dedicated to discovering the true relationship between these aspects and, if I may put it so, to defining the "difference."

His work was crowned with success two years before his death. Working upon the theory that the velocity of motion and the rate of time invariably maintained a constant parallel, he evolved a ray with which he made a

number of objects vanish. It was his claim that the ray speeded up the velocity of electronic motion, causing the atoms to experience time at a faster rate and thus forcing the objects into the future. Of course, he was laughed at.

His discovery was described in the absurdest terms, such as "the automatic disintegrator" and "the death ray." McAndrew left his data in the safe-keeping of the only scientist who believed in him. That scientist was Vanderveen, my superior.

Vanderveen was in the late fifties when he caught the torch cast by the fallen McAndrew. During my association with him he gave me constant, almost fatherly, encouragement. My interest in McAndrew pleased him immensely. When I received my inheritance I told him that it was my desire to use it in carrying on from where McAndrew had left off.

"Weston," he said, placing a hand upon my shoulder, "I have prayed that this should be your ambition. McAndrew, alas! found in me a dog too old to learn new tricks. But as for you—you are young."

Thus the seed was sown. But Vanderveen did not live to see the crop. Twenty-two years later I became the human subject of a time-travel experiment. I had set up my laboratory in the wilds of the Peak District of Derbyshire, in England, where work could be carried on with the minimum of interference. From this laboratory I had dispatched into the unknown, presumably the future, a multitude of objects, including several live creatures such as rats, mice, pigeons and domestic fowl. In no case could I bring back anything I had made to vanish. Once gone, the subject was gone forever. There was no way of discovering exactly where it had gone. There was nothing but to take a risk and go myself.

To this end I designed an air-tight time-travel room and had it fabricated immediately. The room was capable of holding the much perfected Schweil-McAndrew ray projector, myself and a quantity of material I considered necessary to take with me. The projector fitting was designed so that the entire room, with all its contents, would vanish immediately the ray was turned on. I knew, of course, that if this room actually transported me into the future it was imperative that I take into account the possible alteration of ground contours over the period of time I covered. It would be foolhardy to experiment at a point where the ground might rise and leave me embedded yards below Earth's surface. So I hired a field upon a hilltop nine miles northwest of Bakewell—a very lonely spot; and equipped the roof beams with a parachute of my own design, to thwart an opposite possibility.

Upon the fourteenth of April, A. D. 1998, all was prepared for the great test. My financial affairs had been settled with an eye to the future in more ways than one. The time-travel room, lavishly set with windows and looking like a very large telephone kiosk, stood waiting in the middle of Farmer Wright's field. As I walked toward it, not knowing what Fate held in store for me, I thought what an incongruous object it looked standing amid the furrows. Without the slightest hesitation, I unlocked the door, stepped inside and relocked it, started the air-purifying apparatus, took one last look at Earth, fresh with the aura of spring, and closed the projector switch.

IV.

THE SENSATION of being under the influence of the rays was weird in the extreme. My mind seemed to be emptied of all thoughts, retaining only alternating impressions of roughness and smoothness, stickiness and gloss,

for all the world as if the very nature of my brain material was swaying between a pseudo-fibrousness like that of pulled toffee and a satisfying softness like that of a newly rolled ball of putty. A veil of mist came between myself and the world I strained my eyes to see. The mist was elusive, intangible. Some temporary optical fault intervened to defeat all my efforts to decide whether this mist lay over the windows of the room or was coating my own eyeballs.

A sudden panic assailed me, and I pressed down the switch handle to which my right hand was still clinging. A sensation of immense strain racked my body from hair to toes, my blood vessels fizzed as if their contents had been replaced with soda water. The fugitive mist was whisked away like the gauzy veil of an oriental dancer. I felt as sick as a dog.

My key clicked in the lock of the door. I stepped outside and looked around. Everything looked exactly as I had left it. The field was still furrowed; a few trees and bushes were displaying their awareness of spring; the sky was still cloudy, the air as stimulating as before. My experiment had failed.

It was a miserable man who wended his way along the lonely lanes to his laboratory. I remember that birds were singing, but I did not hear them—at the moment; early flowers were adding their sweet beauty to this ugly world of mine and I did not see them—just then.

Mentally cursing my lack of foresight in not parking my car in the hired field, I turned a bend in the road and began to climb a hill lying between the field and the laboratory. A farm laborer emerged from a lane to my left and trudged along behind me. He increased his pace, caught up to me and requested the time. He was an old man of the garrulous type and, to my mind, his question was merely an excuse for a conversation. Nevertheless, I lugged at my gold chain and glanced at the cheap timepiece hooked upon its end.

"I'm sorry," I said, "my watch has stopped."

"So has mine," he responded. "Guess I'll have to get it on the wireless when I land home." He lighted a cigarette and climbed up the hill in silence for a little while. "What d'you think of the great rocket flight?" he asked suddenly.

I had some difficulty in gathering my wits, and had to make a definite mental effort before I could reply. Somehow, I managed to recall the sensational flight across the Channel of Robert Clair. This had been hailed as the first really successful experiment with a man-carrying rocket. If I remembered rightly, the event had taken place at least a month before. The science of rocketry held the interest of only a very small number of people; it was strange that this old man should still betray an interest in such an event placed a month earlier. Courtesy demanded a reply.

"Merely another step in the inevitable march of progress," I answered.

"D'you think they'll ever get to the Moon?"

"Who can tell," I said evasively.

"Well, they're talking about it; they're talking about it," he persisted. "I was reading in the papers only the other day that some professor had worked out how long it would take to get to Venus, how a suitable rocket could be built and how much it would cost. Always thought Venus was a naked woman, not a planet. Shows how knowledge has advanced since my younger days."

"Ah! it is the fate of all of us to be considered ignorant by later standards," I soothed.

"WHAT'S the world coming to?" he demanded, puffing furiously at his

cigarette. "What with steam engines, then motor cars, airplanes and them auto-whatyamacallits that look like windmills and have got no wings, stratosphere planes—and now rockets! I remember when I was a kid there was a furor in the papers because Ginger Leacock circum—circum—went right round the world without a stop, in one of them crazy old stratosphere planes. They've gone round six times since then and aren't satisfied with that! So they've started meddling with rockets.

"First of all some maniac hops over a house and breaks his neck. They called him 'a martyr to science.' Then another idiot who wants to be a martyr rockets across the Channel and breaks both his legs. Not to be outdone, another fool starts out from Dublin and plunges clean through a skyscraper in New York, smearing himself all——"

"Here!" I interrupted. "What the devil are you talking about?"

"Rockets," he replied, startled. "And now when they can get from here to New Zealand in twenty-four hours, including stops, or eighteen hours without, what *I* say is——"

"Will you listen to me," I shouted, grabbing him by the shoulders. "What, in Heaven's name, are you talking about?"

"No offense, guv'nor, no offense!" he said nervously, trying to draw back. "I didn't mean anything, really I didn't!"

"Of course there's no offense," I roared. Then, realizing that my behavior was making the man nervous, I calmed myself and continued in quieter tone, "You must pardon me. This subject you have been talking about is one that interests me very considerably and, for certain reasons, I have been out of touch with the news concerning it. My foolish excitement was caused by your mention of a rocket flight to New York. Will you tell me when that flight took place?"

"Now let me see!" Apparently reassured, he stood and contemplated the skies while he exercised his memory. "As near as I can guess it was in the late summer of 2004."

"What year?"

"2004," he repeated.

"And when was this great rocket flight to which you alluded in the beginning?" I asked, making a tremendous effort to control myself.

"Yesterday."

"You will think this a strange question," I told him, "but there is nothing seriously wrong with me. I am suffering from a slight trouble with my memory. Now tell me, what day was yesterday?"

He looked sympathetic, pulled a folded newspaper from his left pocket, opened it with deliberation and handed it to me. A two-inch streamer was spread across the top of the front page. It said: NEW ROCKET RECORD. Beneath appeared: TO N. Z. IN EIGHTEEN HOURS—Lampson Crashes In Hawkes Bay. I took little notice of this news, red-hot though it was. My eyes searched eagerly along the top. There it stood in plain, indisputable print: DAILY VOICE—May 22, 2007.

Before the startled native had time to move I had seized him and kissed him. I flung his paper into the air and caught it with a mighty kick as it came down. I whoope-e-ed at the top of my voice and danced a fandango in the roadway. My hat fell off and rolled without hindrance into a ditch; my watch jumped out of my pocket and danced in sympathy at the end of its chain. My time-travel experiment had *succeeded!* For a space of five minutes I went stark, staring mad, while my erstwhile companion, forgetting the dignity of age and his rheumatism, galloped up the hill like a hunted deer and vanished over the crest.

V.

THE remarkable feat of making a short trip through time had an effect upon me totally different to what I would have prophesied a few years before. I did not rush, flushed with triumph, to place the news before an astounded world. On the contrary, I became as suspicious and as secretive as any village miser. My desire for fame and the respect of the scientific world faded away, being replaced by a curiosity so insatiable that each to-day became a mere period of speculation about to-morrow. The future had grasped me like a vicious drug.

Formerly, I was secretive because I was determined not to permit my work to fall into unworthy hands. Now, the motive was fear of being deprived of the means to satisfy my desire to explore the future as thoroughly as possible.

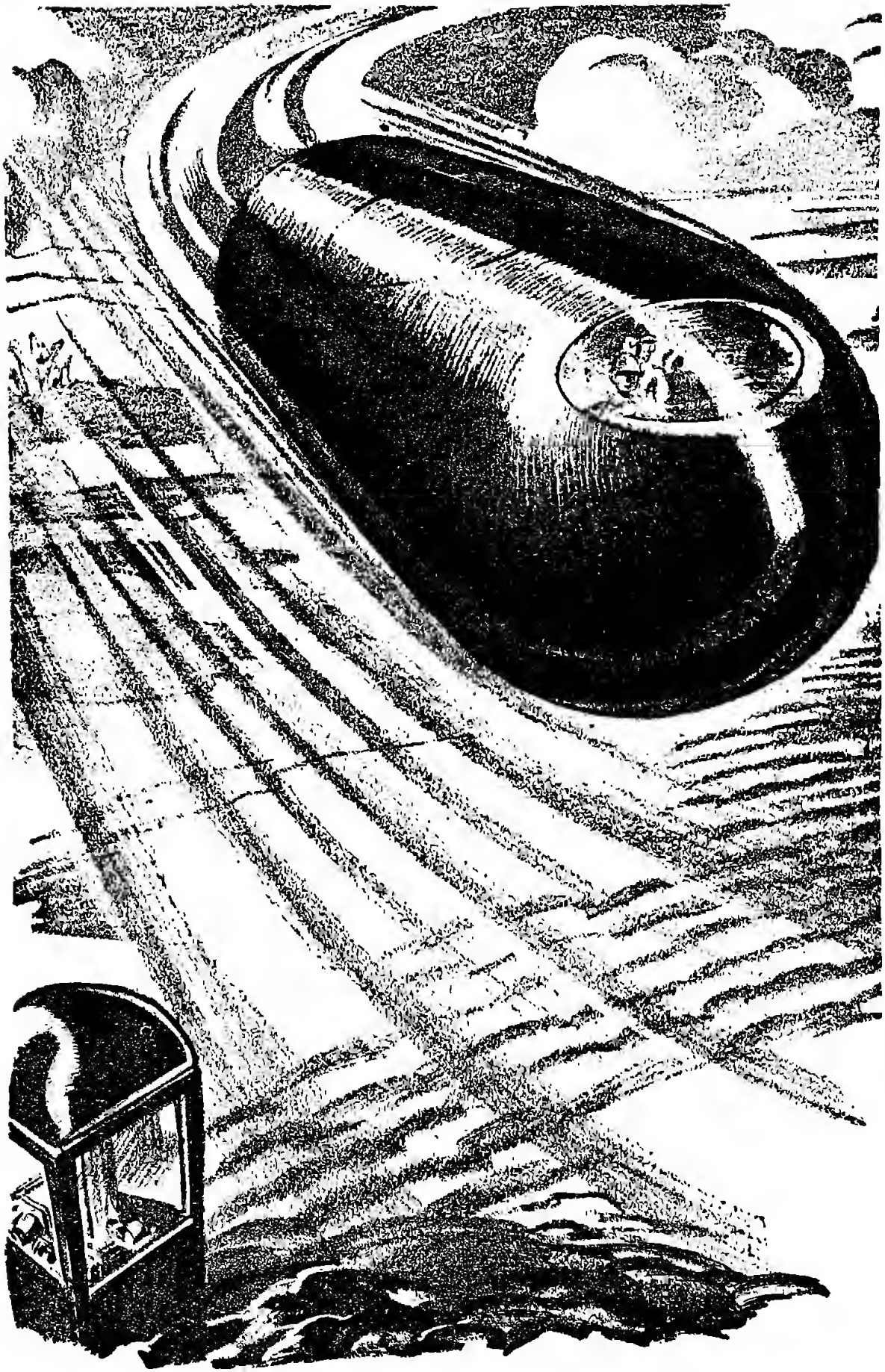
From every point of view it seemed highly desirable that my next venture be undertaken at once. My personal fortune became a matter of little moment; my money was cached securely—but not securely enough to withstand the onslaught of time. I came to the conclusion that I could afford to ignore the fate of my worldly possessions; it was not likely that I could claim them at a distant date.

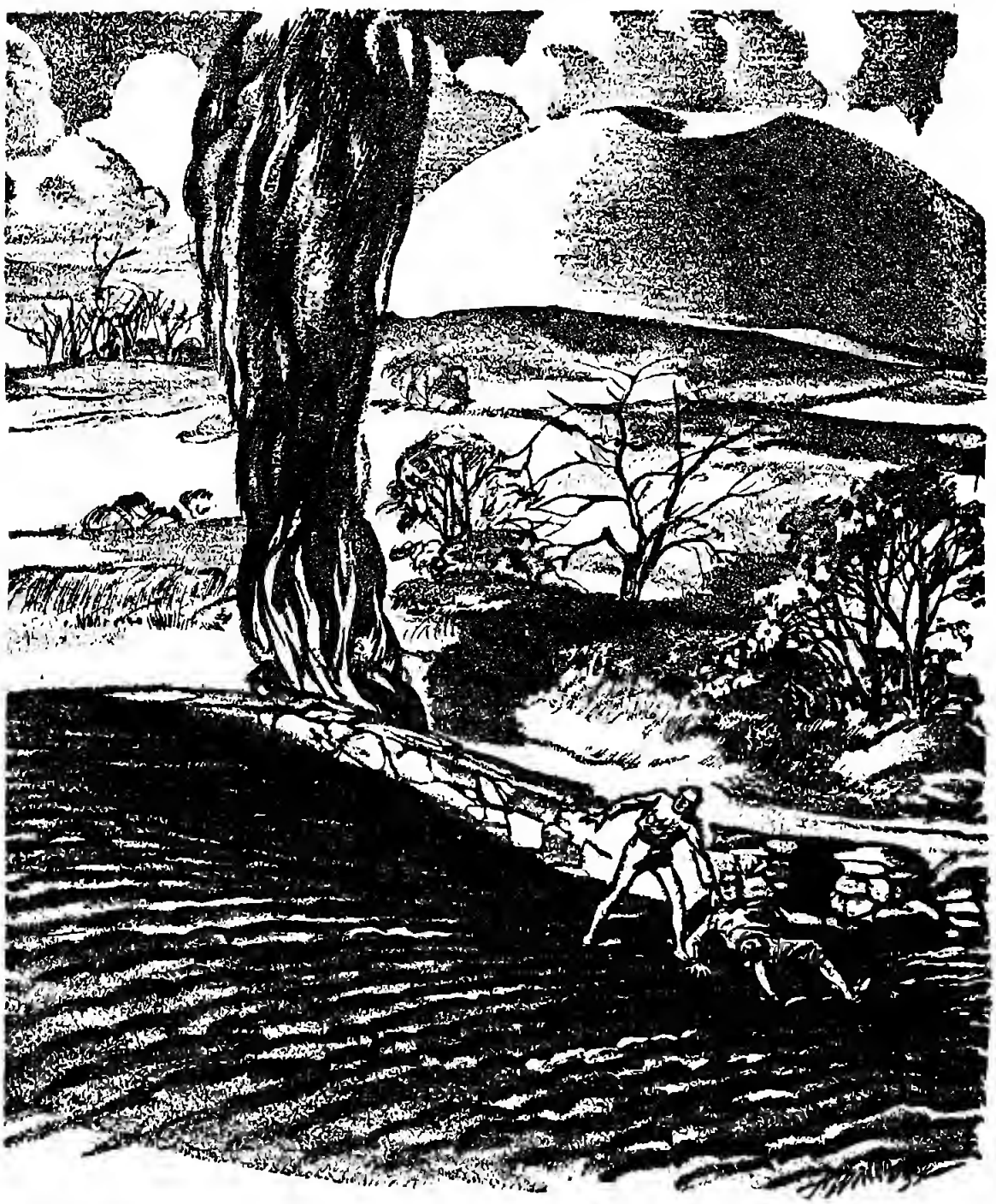
In the quiet atmosphere of the dust-covered laboratory, I thought it over. The time-travel room must be removed as soon as possible. Heaven alone knew what weird story had been told by my late companion upon his return home, what curious eyes and prying fingers would explore the object in Wright's field. Come to that, I did not know whether the field still belonged to Farmer Wright. The owner, whoever he might be, could arbitrarily uproot the trespasser upon his property. My next move must be made that night.

It was an hour after sunset when I entered the time-travel room and locked the door preparatory to my second adventure. My stomach was empty; the laboratory had been devoid of food and nothing had passed my lips for several hours. I consoled myself with a nine-year-old cigarette—still fresh! Faint streamers of light still permeated the sky in the direction of Staffordshire; a crescent moon hung low and stars twinkled clearly. The cigarette surrendered its last fragrant puff. I stamped on it and said, "Good-by, 2007!"

With my hand on the switch, I hesitated. On the last occasion the switch had been closed between six and ten seconds, as near as I could estimate, and I had covered nine years. Was the distance traveled in direct proportion to the time the switch was closed? Would I drop dead when the rays carried me to the very day that Nature intended to be the day of my death, or, whether it seemed logical or not, could one travel past what should be one's day of death? Silence answered my unspoken questions. There was nothing for it but to find out. It was a straight issue of success or suicide. I rammed home the switch with exaggerated determination. The die was cast!

I shall not weary you with another description of the sickness that I have called time nausea. The rays operated for a period about ten times longer than the last occasion—about one minute. Then the switch was opened; my body was subjected to a powerful but momentary strain and I had arrived. The key clicked in the door lock; the door swung inward. With my eyes raised to the distant hills, I stepped out. Something snatched at my unwary feet and I fell upon my face. Regaining my feet, I discovered that the time-travel room was sunk into the soil to a depth of six inches, I had been tripped by the step of earth outside the door. It was fortunate that I had not fitted the time-





"Heaven help——" I began, paused as a thought struck me. "The time-travel room! We'll be safe there——"

travel room with an outward-opening door and thus imprisoned myself.

Looking around me, the first thing I noticed was that the field was uncultivated. A few miserable trees and bushes displayed their last tattered rags of brownish foliage. The sky was gray, angry and overcast; I concluded that it was late autumn or early winter. There was not a soul in sight as I paced across the field toward the lane.

Reaching a stone wall, about four feet in height, I mounted it and surveyed the distant horizon and the intervening terrain. There was not a sign of life or human habitation. My eyes roamed eagerly around, caught a glimpse of an

inexplicable shape in the mid-distance, about four miles away. I took out my spectacles, polished them and adjusted them carefully on my nose. The object was a huge hemisphere of drab color.

The edifice, if such it was, bulged from the top of a tor like a wart upon an Earthly nose. It lay in the opposite direction from where my laboratory stood, or had once stood. I felt very hungry; my stomach suggested that this, the only artificiality on the landscape, held promise of food. I jumped down from the wall and trudged in the general direction of the distant tor.

Maintaining a rapid pace for best part of an hour brought me to within a few hundred yards of the object which had resolved itself into a great, smooth hump of concrete about one thousand feet in diameter by five hundred feet in height. There seemed to be a large hole in its top. I did not get a chance to pause and examine it before proceeding nearer; I hesitated in my stride and a voice materialized out of the air behind me. It spoke in accents curiously clipped, somewhat as the Scottish speak, briefly and to the point. It said, "Keep it up!"

I whirled around. Facing me was a man in dark-brown clothes cut in the manner of a compromise between an engineer's dungarees and a soldier's uniform. A helmet, nothing more than a dull metal skullcap, rested on his head; his hands grasped and pointed at me an object bearing only the faintest resemblance to a rifle. His attire was quite devoid of decoration; it made him look like something between an infantryman and a plumber.

"Where did you come from?" I exclaimed.

"Under a gooseberry bush," said he, grinning broadly. "Where did you?"

"From the year 2007."

"Indeed! Then the past is rising up against us!" A tinge of sarcasm suffused his voice, but he appeared to be an intelligent fellow.

"You must believe me," I argued. "My tale is very long, but when you have heard it you will find it——"

"Very plausible!" he interrupted. "If you're a better liar than most of us, you must be good. Now, get going. You can tell us all about how you saved the world in 2300 when you get inside."

"2300! Did you say 2300?" I tried to clutch his arm.

He placed the muzzle of his weapon against my middle. "Of course I said 2300. Move those feet of yours a little more and your tongue a little less. And, just in case you want to keep up the play, Methuselah, may I anticipate a question by informing you that this is the year of disgrace 2486?"

"Good heavens!" I cried, turning and moving up the hill. "I've jumped nearly four centuries!"

"Right out of the frying pan into the fire," my companion remarked.

"Why, what d'you mean?"

"Exactly what I said," he answered, his face taking on a sardonic expression. "You may be a good jumper, but you're a darned poor picker. Why didn't you jump a little less or a good bit more? The jumper who picks on this year is crazy. Hell, I knew you were crazy, anyway!"

"Yes, but——"

"Walk on, jumper, walk on!" he commanded. "I don't want to use my economy gun on a white man, even if he is cracked."

"Why d'you call your weapon an 'economy gun'?" I asked him.

He heaved a sigh. "Well, if you must talk, and if you must pretend ignorance of commonplace things, it's because it uses poisoned darts propelled by compressed air and thus saves expenditure of explosives that are sorely needed elsewhere."

I was about to ask him where the ex-

plosives were needed, and for what purpose, when I found that we had arrived at the foot of the concrete mound and were facing a metal door set in its side.

My companion touched the door and slid aside a small trap set in its center, revealing a fluorescent screen behind. He faced the screen and spoke. "Number KH.32851B4, with a gentleman from the year 2007."

VI.

THE DOOR opened silently. We entered. Facing us was a long passage indirectly illuminated from slots set in the sides. With synchronized step, which aggravated me and which I vainly tried to break, we marched down the passage, turned to the right at the bottom, *clump-clump-clumped* along a concrete corridor and entered a large room.

A leather-skinned, mustached individual looked up from his desk. "What do you want?" he snapped.

"Food," I answered, briefly.

"Bring him food," he said, addressing my guardian. Turning to me, he said, "Sit."

A high cube of red rubber squatted on the floor behind me. I seated myself on it gingerly. It was an air cushion and it felt luxurious. The man behind the desk leaned forward, switched on an instrument bearing a vague resemblance to the old-time voice recorders. He stroked his mustache and looked me over.

"Name?" he demanded.

"Professor Glyn Weston."

"Professor, eh? Of what seat of learning?"

"Originally of Glasgow Observatory; since then I have been working in my own laboratory, about nine miles from here."

"There is no laboratory within a dozen miles of here," he said, acidly.

"My laboratory was within nine miles of here in the year 2007," I replied, doggedly.

"In 2007! How old are you then?"

"From one point of view I am a little over fifty, from another I am nearly five hundred."

"Absurd!" he exclaimed. "Obviously absurd!"

"There is an explanation for this seeming absurdity. In the year 2007 I was the first man to have made a trip in time—that is to say, into the future. I had traveled to that year from 1998. The experiment has been repeated. This is the result—I am here!"

"Hah!" He rubbed one side of his nose with a forefinger and regarded me queerly. "The popularity of science-fiction has made the subject of time travel quite familiar to us. But time travel is impossible."

"Why?" I asked.

"It is illogical."

"Life is illogical; earthquakes are illogical."

"True," he agreed. "From some aspects that is profoundly true. But can you reconcile yourself with the idea of shaking hands with your ancestors a few centuries before you are born?"

"No—that would be really illogical. My experiments have shown me that time can be traveled in one direction only—and that is forward, into the future. There can be no returning, no motion into the past by as much as a fraction of one second."

He stood up, moved away from his desk toward a corner bookcase, searched along the serried volumes and pulled out a large, black tome. He ruffled its pages. Turning to me, with the book open in his hand, he questioned me. "What was the population of Bakewell in 2007?"

"I cannot tell you," I replied. "I spent very little time in that year. But in 1998 it was about 4500."

"Hm-m-m! Who was the Premier of Great Britain?"

"Richard Grierson."

"Correct! Clair flew the Channel that year. Who designed his rocket?"

"The German astronautical experimenter, Fritz Loeb."

"Again correct!"

"Listen to me," I begged. "If that's some sort of ancient encyclopedia you've got there, please turn up the time concept and see who wrote books about it."

He wet a finger, searched through the pages of his book. Placing it on the desk, he grabbed another and searched through that also. Four books were explored before he found what was wanted.

"Here we are. By the way, my name is Captain Henshaw," he added, as an afterthought. "Let me see, Schweil, Herman, philos. Dutch 'Der something-or-other'; Schweil again, with another book; McAndrew, Fergus, 'Space-Time Coördinates'; McAndrew again, 'Time-Motion Relationship'; Weston, Glyn—well I'm a yellow man!—Weston, Glyn, 'Atomic Acceleration In The Time Stream'; again: Weston, Glyn, 'Schweil-McAndrew Theories Simplified'. Another and another; one, two, three, four, five, six! Glyn Weston—that's *you!*"

"And I can prove it," I said, feeling supremely satisfied that my work had been recorded over five centuries.

"How?" asked Captain Henshaw.

"My time-travel room stands awaiting your inspection at a place that I can describe to you only as Farmer Wright's field. It is an hour's walk from here."

A DOOR to my left-hand side opened suddenly. A uniformed man appeared wheeling a dinner wagon constructed of bright metal tubes and mounted upon doughnut-tired castors. He twisted the wagon dexterously, turning it before my seat, lifted a well-loaded tray from the top and, with the casual air of an expert conjurer, drew four telescopic legs from its underside. Adjusting the contraption to a nicety, he stepped backward, flourished a cloth and bowed with an impudent grin.

"You must be hungry after five hundred years of abstention!" he said. Throwing another grin at Henshaw he marched from the room.

"To be perfectly candid with you," said Henshaw, as I commenced the welcome meal, "your story is too utterly ridiculous to believe, despite the evidence you have to offer. Now don't think that I am about to call you a liar, for I am not. All that I can say is that I intend to keep an open mind about the matter until I've had the opportunity to examine this magic kiosk of yours, and I am going to take a look at it immediately my spell of duty ends, in about two hours' time."

"You are welcome," I mumbled with full mouth, waving a fork in the air.

"After I've taken a look at your gadget, I'll make a report to Manchester. My superiors can then decide how to treat you."

"Sounds threatening," I remarked, chewing rapidly.

"And, just in case your story happens to be true in every respect, is there anything you would like to know?"

"Yes!" I speared a potato. "Where am I?"

"You are inside No. 37 Interceptor Fortress." He moved from his desk and began to pace the room.

"No. 37 what?" I asked with sudden energy.

"Interceptor Fortress," he repeated. "There is a war on."

"A war!" I echoed, feebly.

"The biggest and most ferocious war the world has known. It has been on for the last five years and looks like lasting for the next five. One tenth of Earth's population has been wiped out, obliterated. The Metropolis, which was called 'London' in your time, no longer exists except as a great area of shattered bricks, slates and concrete,

which harbor the bones of those they harbored in life. If you can travel in time, as you say you can, you will live to curse the invention that plunged you into the present day." Henshaw's face grew bitter, his voice hoarse.

"With whom is Britain fighting?" I asked, my dinner almost forgotten.

"There is no Britain," Henshaw answered. "The name was given up two centuries ago. There is no British Empire, either. You are now living in England, which is a self-ruling state and part of the White World, just as Scotland, Ireland, Australia, Germany, Russia and all the others are part of the White World. The Earth of to-day has only three divisions: the White World, the Yellow World and the Brown World.

"The Brown World is the smallest and most insignificant of the three. It includes the so-called black races and is neutral—up to the moment. The White and Yellow Worlds are decimating each other to assert their right to breed regardless of the room available. But I am disturbing your meal; please finish it and I will take you to the telescan room. There I can show you something of the war."

My mind pestered by a dozen vagrant thoughts, I ate in silence, while Henshaw fidgeted before the bookcase, taking out volumes and putting them back again. Eventually, the meal came to an end. I drank the last drop of liquid, munched the last fragment of biscuit and arose.

Henshaw signed toward the door through which I had entered. We passed through it, moved down a long corridor, through another door, up a corkscrew staircase into another corridor, reached its end and found ourselves in a long, rectangular room set under the roof of the fortress.

"This is the telescan room," said Henshaw.

VII.

THE WALLS and floor of the room were littered with a mass of instruments and equipment. Four men were moving about in the jumble, occupying themselves with various jobs, while, at the distant end, two more were seated at what I deduced to be control boards of some description. The most prominent object was a great glass disk secured in a metal frame in the center of the floor. The disk was tilted slightly out of the horizontal, had a mirror surface and bore a strong resemblance to the astronomical reflectors of my own day.

Henshaw produced a chair from somewhere. Placing it near the mirror, he bade me be seated, moved to the men at the control boards and held a brief conversation with them. He returned and stood by my chair.

"This telescan was the result of permitting amateur short-wave experimenters to play with television. It is much too complicated to explain to you here but, to put it briefly, a beam is directed into the sky, passes through the Heaviside and Appleton Layers and rebounds from the Grocott Layer, which lies at an altitude of about eight hundred miles. The beam then returns to Earth and catches the scene at its striking place.

It bounces right round the Earth, registering the scene wherever it happens to strike; the first impression is the strongest, and when we pick up the beam again we have no great difficulty in tuning out the confusion of underlying scenes, leaving the first clear and sharp. The operators are now trying to angle the beam to give us a view of the Metropolis. We should get results any second."

Even as he spoke, the mirrored disk came to life with startling suddenness. There was no preliminary clouding or blur. One moment the surface was devoid of all but glitter; the next moment

it depicted a scene with astonishing clarity. I leaned forward and looked at it.

A ruined road, pitted with ragged craters, passed through an area filled with hummocks of crushed building material. Carefully though I searched, I could not perceive one place where two bricks still clung together, neither could I find a single unbroken brick. The scene maintained a harrowing uniformity from the foreground to the background, a square mile of pathetic evidence.

Nothing stirred in that dismal scene; no step was taken where once ten million pairs of feet had trod; no voice was raised where the voices of children once were raised in play. A lump came in my throat, as I realized that the Metropolis—dear old London—was no more. It lay like a great, gray scar upon what I still imagined as the sweet green face of Mother Earth; it lay like a scar upon the soul of humanity.

THE MIRROR altered its focus as the men at the end of the room manipulated their controls. The nearest end of the road seemed to rise toward me and show itself in greater detail. I saw bones protruding from a mound of dirt fifty yards from a large crater; near the legs lay the flattened skeleton of a dog. Henshaw bent his head forward, rubbed his chin with a harsh, scratching sound and spoke.

"Before you lies one of the most heart-rending incidents of the war. The dog refused to leave its stricken master. It stayed there until it starved to death. Thousands of people watched its long, drawn-out act of devotion, watched it through the telescan with curses and tears born of helplessness. Flight Lieutenant O'Rourke, disobeying orders, made a mad attempt to rescue the dog about the time its belly disappeared into its ribs. He was brought down by a Yellow squadron. His rocket plane is mixed with the dust of the Marble Arch. God rest a gallant gentleman!"

"Are the Yellows winning?" I asked, feeling sick at heart.

"No, I would not say that. Warfare has now reached the stage of perfection where nobody wins and everybody loses. The Metropolis, or what is left of it, is in no worse condition than Kobe and Tokyo. The campaign consists of a series of destructive assaults, followed by equally destructive retaliation; there have been no prolonged battles such as featured the past, just a delivering of rapid blows by one side or the other. The end of this great city was the result of such a blow; the end of Tokyo was our reply. Come, we'll take a look at your time-travel room."

With that I arose. We departed from the telescan room; retraced our steps through the corridors and came to the metal door. It opened silently as we reached it, revealing a small, streamlined vehicle standing on the path outside. Henshaw struggled to get his long legs beneath the steering wheel, while I took a seat by his side. Slamming the off-side door, Henshaw pressed a button protruding from the wheel boss. A smooth whir came from beneath the bonnet and we were off.

"Don't take the telescan picture too much to heart," said Henshaw, juggling with the wheel. "We received warning of that raid from our very excellent espionage service and managed to evacuate nine tenths of the population in time. The remaining tenth was wiped out, but the death roll was not as large as the picture suggests."

"What caused the damage," I asked.

"Bombs—high-explosive bombs dropped from the stratosphere airplanes and also from rocket ships flying at tremendous heights. The next raid will be upon Manchester or Sheffield, for these are now the southernmost towns of any importance, also centers of the armaments industry. Our fortress

is one of a chain strung across the Derbyshire hills to protect Manchester. We cannot prevent a raid, but we can administer severe punishment with our rocket shells and our aërial torpedoes, which can ascend to very great heights, the latter by means of power picked up from the North Radiation Station."

"The Continent must have dropped in for it!" I offered.

"Not so much as you would think," he replied. "The opposing forces have vented their spite on what they consider to be the nerve centers of the enemy; thus England and Japan are the favorite targets. Neither side keeps its air fleet for purposes of defense but for retaliation. That is why these fortresses are very important—they are one of the few defense concessions wrung from the powers that be who worship the policy of attack, attack and again attack." He jerked at the steering wheel, avoided the curve of a stone wall and continued in a voice that grew more bitter.

"I am not looking forward to the next raid with eager anticipation. Information has reached us, from certain sources, telling that the Yellows have perfected a disintegrator bomb, the result of some nosey scientist occupying himself with the problem of how solar radiation is maintained. I understand that the bomb drops, bursts, upsets the stability of surrounding matter and causes it to burn itself away.

"The process does not continue indefinitely, but only as long as the original energy in the bomb lasts; the bigger the bomb the greater the area of matter affected. The process was described to me as 'readjustment of electronic balance,' and I believe that it takes place at a rate that will trap all but champion sprinters."

THE CAR went over the crest of a hill. A field came into view. Simultaneously, we saw the time-travel room. We shot down a slight slope toward it, *took an equally slight* rise and came to rest beside the wall from which I had viewed the distant fortress. Henshaw squirmed from his seat, took out a watch and glanced at its dial.

"Four minutes—not so bad considering the state of the road."

"You've averaged about sixty miles per hour," I told him. "What sort of motor is this?" I asked, gesturing to the car.

"Electric. Runs on Freimeyer high-capacity batteries employing silver-tantalum alloy plates." He vaulted the wall, stared at the object in mid-field. "So that's the magic box, eh? Let's go and put a penny in."

I climbed the wall. We started for the room together. Henshaw stroked at his mustache, an expression of keen interest in his face. The turf was damp and slippery beneath our feet. We had covered half the distance to the room when a hoarse whistle ran over the hills and echoed in the valleys. Henshaw stopped abruptly. The whistle ended, then was succeeded by six short toots.

Henshaw whirled around, grabbed me by the arm, pulled me toward the car. "By the Mandarin's Button," he roared, his face red with excitement, *"a raid!* Did you hear the siren? It's a raid warning from the fortress. We must return at once! Put a move on, for Heaven's sake! There's not a second to lose."

We ran toward the wall. Twenty yards from it I slid, staggered with wildly waving arms, slid again and fell upon the flat of my back with force that knocked the breath from my body. Henshaw, half a dozen jumps ahead, skidded in a circle, returned and grasped my hands, preparatory to helping me up.

"Look!" I gasped weakly, my eyes bulging at the sky. *"Look!"*

About a mile away, coming in our direction at a fast pace, was a golden-

colored air machine shaped like a bullet, small, stubby wings protruding from its sides, a long tail of fire streaming from its rear. It looked sinister, threatening; my heart turned to ice.

"By Hades! a fighting scout of the Yellows," shouted Henshaw. "He's got us spotted and intends to have a little amusement. Run like the very devil. We're as good as dead men already."

So saying, he gave a tremendous heave that swung me to my feet. I clutched his shoulders. We swayed about like a pair of adagio dancers, slipped and went down together. Somebody rattled a piece of rock in a monster can; a roar swept overboard; a flood of hot air washed our recumbent bodies. We regained our feet. The scout had passed us by a mile and was nosing upward in a great loop. The car was a smoking ruin.

"He's coming back for us," Henshaw screamed. "We're done. There's nowhere we can hide!"

"Heaven help——" I commenced, paused as a thought struck me. "The time-travel room! Come on. We can make it with luck. We'll be safe there."

VIII.

I TURNED, made for the center of the field, arms working like pistons, my pace hampered by fear of falls. Henshaw raced beside me, his chest laboring, his face livid.

Despite the telling pace, he found breath enough to ask a question as he ran. "What good will it do to get into that thing? He'll simply blow it sky high!"

"Wait and see!" I grunted.

A noise grew loud behind us, filling us with fear that added to our speed. With surprising suddenness, the scout roared overhead followed by its wake of heated air. A terrific blast came somewhere in the rear. Henshaw looked over his shoulder.

"A disintegrator bomb!" he shouted. "It's eating toward us like greased lightning. Run! Run as you've never run before!"

My protesting feet increased their speed. The total distance from the wall to the room was a bare five hundred yards. I would not have believed that such a distance could be so punishing. Thirty yards separated us from the time-travel room, it seemed like thirty miles. The distance already covered told in this final stage; we did not run it; we reeled it.

Henshaw, ahead of me, reached the room and tugged madly at the door, as a sensation of heat penetrated to the back of my legs. He danced with excitement as he pulled in vain. I sobbed out to him *"Push! Push!"* and he fell headlong inside. A fraction of a second later I staggered through the open door, turned and saw the earth literally melting and boiling within a yard of the step. We were barely in time.

Without further ado, I slammed the door and closed the switch of the ray apparatus. Red flames jumped upward and peered at us through the windows; a film of mist blotted them out. My body tingled with the old, familiar sensation and, as I breathed a prayer of thankfulness, the whole room fell over on its side. My head struck a projection on the wall. Frantically, I tightened my grip upon the switch as I slipped into unconsciousness.

THE PERIOD of stupor did not last long—or it did not seem to. I came to my senses, jerked out a hand in search of the switch, found it and pulled it.

Somebody said, "Ouch!"

I sat up hastily. I was in bed!

My astonishment can well be imagined. I was in bed, there was not the slightest doubt about that. I stroked and felt the clothes, studied the

weave of them and pinched myself. There was nothing else for it: definitely, beyond all dispute, I was sitting up in bed clad in a crimson nightgown.

A half-seen movement to one side drew my attention that way. I rubbed my eyes and looked again. Standing beside the bed, his face expressive of kindly solicitude, was a bald-headed man garbed in rompers of brilliant hue. His forehead was high, his eyes large, liquid and brown, his mouth and chin small, almost womanly. Suspended from a chain encircling his neck was a plated instrument which, I guessed, had taken the tug that brought forth the "Ouch!"

I stared at him. He contemplated me with quiet serenity.

"Where am I?" I asked weakly, making use of the conventional phrase under such circumstances.

"You are within my house situated in the city of Leamore," he answered in a pleasantly modulated voice, "and the year is 772 by the new reckoning, or 34656 by the old. You have leaped a chasm of time representing about thirty-two thousand years!"

"How did you know that I am a time traveler?" I demanded.

"Because your time-traveling device materialized out of thin air before the eyes of half a hundred citizens. You chose the center of a busy road as your arriving point. Dozens of people witnessed the phenomenon which, in the far past, undoubtedly would have been given a supernatural explanation. Our solution was that you had traveled through time: a simple solution seeing that your feat is the second within the last five centuries. Finally, your companion confirmed our——"

"Henshaw!" I interrupted, realizing that I had company on my time trip. "Henshaw—— Where is he?"

"He is having his hair plucked," was the amazing response.

"Hair plucked! *Hair!* Why? What?" My mind relapsed into confusion at this nonsensical twist in the conversation. For the second time I pinched myself to make sure I was not asleep. The man in the blue rompers smiled as he noted the effect of his words. Seating himself on the edge of the bed, he hugged a knee and continued.

"Your friend appears to be a person accustomed to making quick decisions. It is scarcely thirty minutes since your time-conquering device staged its dramatic appearance, yet already he has discovered that, according to present-day conventions, hair is regarded as not nice. Apparently he is determined to look nice at all costs, so he is having his hair removed by a painless method of extraction. We are depriving him of his mustache and head covering. The bristles on his face will have to grow longer before we can deal with them."

"WELL, I'm damned!" I exploded. "Henshaw—the blessed goat! I boost him through a multitude of centuries and what happens? He rushes into a beauty parlor leaving me to expire in bed." Indignation brought me out of the bed and to my feet. "In a crimson nightgown!" I added.

My companion laughed aloud. "No fear of you expiring just yet," he assured me. "You received a nasty bump from which you will recover very soon. As for the nightgown, as you call it, we put you into it after giving you a much-needed bath, while we looked around for some suitable clothes."

"What's wrong with my own clothes?" I demanded.

"They have been burned; your friend's have been burned, also. The contents of your pockets have been fumigated; so has your time-travel room. This is a hygienic world you've stepped into. We don't mind you coming here, but we object, in the strongest possible manner, to you importing large

quantities of germs of types that we have gone to considerable pains to eliminate. We like you; we like your friend; we *don't* like your passengers."

"Sorry!" I said, humbly.

"It's quite all right," he answered, releasing his knee and standing up. "Perhaps I have been too blunt. The apology should be mine." He walked across the room, pressed a button. A panel in the wall slid silently downward. Behind lay a recessed wardrobe. He reached inside, produced a complete outfit of clothing made of some material resembling silk, tossed them on to the bed.

Removing the crimson wrap with secret relief, I commenced to put on the apparel. The soft, almost dainty material enveloped my bathed, refreshed body pleasantly. There was not a button in the outfit. Everything fastened with a sort of glorified zipper. I pulled on one strangely cut garment after another, zipped them tight and, in the end, stood before a mirror regarding myself attired in emerald-green rompers, green socks and sandals to match, a green tricorn hat cocked rakishly on my head. I stared into the mirror, thinking it depicted the biggest fool alive.

"How do you like it?" questioned the onlooker.

"Not so bad. All I want now is the cat."

"The cat?" he repeated, mystified.

"Yes, the cat. I look like the principal boy in Dick Whittington."

"Dick Whittington?" he muttered.

"You wouldn't know about that—let it pass!" I tried the tricorn at a different angle; the result was an abomination. Finally, I gave it up. If all of them dressed like this, an extra idiot wouldn't be noticed.

"Well, I'm ready, Mr.—Mr.——"

"Ken Melsona is my name," he responded.

"And Glyn Weston is mine." We shook hands. Melsona opened a door, led the way down a passage to another door, which sank at the pressure of a button. Outside lay the street. Conscious of my unfamiliar garb, I hesitated; Melsona, dressed like Little Boy Blue, stepped boldly out. I followed.

IX.

BEFORE ME stretched a scene so unexpected I stopped and gasped. Between the pavement curbs ran a moving roadway, smooth, soft-surfaced, flowing evenly from west to east. It was divided into three sections, all traveling in the same direction, the outer sections at about five miles per hour, the middle section at about ten. Hundreds of people clothed in gaudy colors stood and chatted on the road or stepped from one section to another, all carried along steadily like an array of targets in a gipsy shooting gallery. The total width of the roadway was about one hundred feet; fixed, mosaic-patterned pavements bordered it.

Picturesque villas set in lavish, well-cultivated gardens lined the roadway on both sides. Ornamental trees of every size and color, drilled and trimmed into every conceivable shape, sprouted from the pavements at intervals of thirty yards. It was a beautiful sight indeed, the most beautiful I had ever seen. The road deserved the name of Boulevard of Heaven.

Melsona made for the nearest-moving section of roadway, warning me to step on it while facing the direction of motion. We passed over to the middle section, stood upon it, side by side, and glided to the east. I felt as pleased as a kid at a fair.

"Let us call at one or two shops," suggested my guide. "Then we can pick up your companion—er—Henshaw you said his name was, didn't you?"

I mumbled an affirmative, my eyes roaming busily over the scenery and the accompanying crowd of road-riders,

It did not occur to me to wonder why a space ship should fly over an airless world——

my mind inveigled by the novelty of it all.

We swept along for the best part of a mile, before Melsona nudged me into attention, dexterously transferred himself to the right-hand slow track, crossed it and gained the pavement. With me tagging behind, he made a bee line for a section of half a dozen shops, entering one displaying a mass of goods I had not the time to examine. A man and a woman, both brightly clad and equally bald, advanced eagerly at our entrance.

"Pray serve this gentleman," said Melsona, making a patronizing wave in my direction.

"Ah, certainly, it is a pleasure," purred the male assistant, washing his hands with invisible soap. "What is the gentleman's need?"

"Money," I said, succinctly.

"Money!" he parroted. "Money! What a strange request! It is obtainable, of course, but you will have to apply to a collector."

"Then how the devil can I——"

"It's quite all right," Melsona interrupted. "All you have got to do is to ask for whatever you require. If this shop has it, you will get it; if it hasn't, then some other shop may stock it."

"Ask and it shall be given unto you," I quoted. The idea sounded crazy to me, but who was I to question the economics of this age? "Cigarettes," I said, hopefully.

The words were no sooner out of my mouth than the lady assistant darted to a shelf, beating her confrere by a foot, grabbed a dozen packages of assorted size and shape and placed them on the counter. My eyes stared in astonishment and delight. They were packets of cigarettes. I took one of the biggest. The lady wanted to know whether she could provide me with anything else. I asked her for a cigarette case and got it. I asked her for an automatic lighter. She provided me with a replica of the instrument dangling from Melsona's neck, which I had mistaken for the switch. I spent thirty minutes in that shop, emerging convinced that I had stepped into Utopia.

WE STOOD on the pavement outside. I opened my cigarette packet, placed a welcome tube between my lips, and Melsona showed me how to use the lighter. It was shaped like an elongated fir cone, made of metal and affixed to the conventional neck chain. One merely squeezed it. A small lid in the wide end popped open, revealing a glowing filament underneath. I lighted it, inhaling the fragrant smoke with indescribable satisfaction.

"How long will this last?" I asked, studying the glowing end of the lighter curiously.

"For the whole of your lifetime," answered Melsona. "It's——" He looked upward suddenly, as a loud noise thundered down from the clouds. "Look! There's a world-trip liner!"

Overhead soared a titanic cigar, silvery-colored, flame-girt, awe-inspiring. The circumstances made it hard to grasp the true perspective. I judged the monster to be about a mile in length and a tenth of a mile in diameter. Poised high above the thin, almost transparent clouds, it was truly a majestic sight, its conical nose pointed toward the Sun setting in the west, its tail vomiting spears of flame that spread, lightened and resolved into an enormous fan of vapor.

It was moving at a height of at least seven miles, yet its size and the wonderful clearness of the atmosphere made the rows of circular ports along its sides easily discernible. Barraging the whole city of Leamore with a bombardment of sound, it sped swiftly to the west, its tremendous bulk dwarfing the antlike humans responsible for its fabrication.

"What do you think of that?" asked Melsona, proudly.

"It's magnificent! It's marvelous!" I said.

A shout drew our eyes to the roadway. A man standing on the distant five-mile track waved madly, rushed in our direction, trod on the edge of the intervening ten-mile track and executed an incomplete cart wheel. With the road rushing onward beneath him, he rolled full length in the contrary direction, mowing down people by the dozen. Still rolling, he broke out of a knot of recumbent forms, revolved across the track and tried to regain his feet on the very verge.

He stood up, for a fraction of a second, with one foot on the middle track and one foot on the nearer five-mile track; then the difference in speed overcame him. He chose the five-mile track and sat on it, hard. He passed us, as we gazed with interest, lying flat on his back, his feet in the air. Fifty yards along the road he gained the safety of the pavement with a sudden, acrobatic movement, turned and dashed toward us.

As he neared, I perceived that he was darker in complexion than most of the people I had seen. His rompers were a horrible yellow above the waist and black below; his socks were of black; his sandals black with yellow piping. A yellow pork-pie hat was rammed squarely on his head; a yellow tassel hung from the center of its crown and dangled over his left ear.

"Weston!" he bellowed. "It's me—Henshaw!"

HE CAME up to us, his face beaming with pleasure, and smacked me heartily on the back. I studied him closely. He was as hairy as an egg.

"I don't believe it," I said, flatly.

"I can hardly believe it when I look at you," he retorted.

"Then how did you recognize me?"

"Because yours is the only monkey nut in the whole wide world." He took a pace back and surveyed me from head to heel. "The only original Robin Hood, as I live and breathe," he said. "How d'you like my rig?" He spread his arms and slowly rotated before us.

"I would rather not say," I said, averting my eyes from the bilious yellow, "justice can be pronounced only in vulgar terms."

"Jealous!" was his laughing comment. "Personally, I think attire such as this lends color to life. If I've any fault to find, it is only the trouble it creates in distinguishing sahibs from memsahibs. So you've been shopping, huh?" He jabbed a finger at the lighter suspended from my neck. "And how do you like this moneyless world?"

"Seeing you know about the money, or lack of it, it's evident you've been shopping," I commented.

"Oh, no," he assured us. "I went to pay the hair-plucker and he acted like one thunderstruck. Then I found out about the money. Wistfully, he said he would like an odd coin if I had one to give away. So I let him run through my purse, which I had swiped when they grabbed my clothes to burn them. His eyes stood out like organ stops, when he saw what I had: eighteen dollars and forty-seven cents in good old White money."

"*White* money?" I queried.

"Of course. You didn't think I'd have money from your age, did you? Well, he raked through the lot and picked out a half-dollar piece which was the oldest-dated coin there. He was as pleased as a dog with two tails. I asked him what he was going to do with it. You would never guess what he said."

"What?" I encouraged him.

"I've not yet been able to make up my mind whether I'm mentally deficient or all this world's daft but me. Believe

it or not, he said he was going to swap that half dollar for a *glass fish!*"

"A glass fish!" I echoed, incredulously.

"Now what the deuce could he want with that?" Henshaw continued. "A live fish would be bad enough, a dead fish better, but a glass fish!"

"That can be explained," Melsona interjected. "You see, this world has progressed so far that its one great problem is how to keep people occupied. There is no monetary system; everything can be had for the mere asking. All work, manufacturing and the like, is carried on by volunteers, but so efficient are our methods that there is never enough work for all the people who want it. Inhabitants of this world have to fill up a very large amount of spare time somehow or other; consequently, work, once a curse, is now a godsend.

"How do our citizens spend their spare time? I will tell you. A little less than half devote themselves to science, a little more than half devote themselves to art. People invent things or create things, and everybody tries to make his work individualistic or superior to that of others.

People dispose of the unwanted products of their own handicrafts by placing them in the shops for disposal to the persons who ask for them. The greatest shame any citizen can feel is when one of his products stands waiting in a shop for months. The greatest triumph he can experience is when so many clamor for one of his works that it has to be disposed of by means of drawing lots.

"People who collect the work of any particular artist, or have a special desire to acquire one of his works, can obtain them in three ways: they can get them from a shop for the asking, if the shop happens to have them; or, if the artist is so popular his work never reaches a shop, they can apply to the artist to join with other applicants in drawing lots for his work; or, if the artist happens to be a collector himself they can barter with him.

This explains your man's intention of changing a coin for a glass fish. Coins of your age are not rare; they are absolutely unknown and, therefore, of incalculable pleasure to a collector. One of our most prominent collectors of these old trading tokens is Torquilea, who is Earth's greatest glass artist. I would like you to see an example of his work. Come with me."

X.

FOLLOWING Melsona's lead we marched along the pavement in the opposite direction to the motion of the road. A lively conversation was maintained: it consisted mainly of questions by Henshaw and myself, and Melsona's answers. We gathered that a system of moving roadways radiated like the spokes of a wheel from the center of Leamore to its outskirts, that roads ran inward and outward alternately, that people who wanted to travel in the opposite direction to a road's motion either walked along the pavements or cut through a side street to the next road. This road ran to the center of the city; if Melsona was returning home from the center and did not care to walk, he just took the adjacent road, which ran outward, and entered his house by the back way. All roads exceeding thirty meters in width were moving roads; narrower roads were stable. The whole system of transport was absurdly simple.

Melsona was explaining to us that private air machines and wheeled vehicles existed in large numbers, but were not allowed to enter into, or fly over, any city, confining their activities to the terrain between towns. Just then we passed an open-air café. We did

not go far past; with one accord, we retraced our steps, entered and claimed a table.

"—thus only the great liners bound for city airports are permitted to pass over occupied areas," said Melsona, finishing his conversation. "What will you have?"

"Beef," said Henshaw.

"Beef? What is that?"

"Meat," said Henshaw, licking his lips and easing the belt around his rompers. An expression of ineffable disgust appeared on Melsona's face.

"I was only joking," Henshaw assured him, quick-wittedly. "I'll have whatever you recommend."

Melsona's expression suggested that he did not regard the joke as being in the best of taste. He scribbled on a pad framed in the table's center, rammed his foot on a pedal protruding from the floor. The table sank downward, leaving us gaping into a shaft between our feet. After a short pause the table rose into view, settled before us with its top bearing the three meals ordered. We set to. The food was strange, but satisfying.

Eventually, feeling like a new man, I left the table and, with my companions, continued along the pavement. I fell into a reverie, thinking how queer it was that my previous meal was only a few hours before—or was it thousands of years? We had walked for about ten minutes, when Melsona stopped so suddenly that, still buried in my thoughts, I bumped into him. He pointed to the garden of a beautiful villa.

"Here's a fine sample of Torquilea's work," he remarked. "Come inside and take a look at it." Without hesitation, he opened the gate and stepped into the garden, telling us that our interested inspection would be regarded as most flattering both by the artist and the owner. He led us to an object standing in the middle of the lawn. We looked at it in silence. It was divine; there was no other word for it.

A MASS of colored marble, onyx, agate and lapis lazuli, ingeniously arranged, arose to a height of ten or twelve feet. Over it flowed a mock waterfall of glass so realistic one was shocked by the lack of noise. So superb was the artist's cunning that even the grain of the underlying stone had been utilized to create an impression of subsurface swirls. Embedded in the glass, by what means I could not determine, were bubbles and shadows and vague flickers of light making a perfect simulation of live and dancing water.

The fall broke at the bottom, eddying and spraying among the colored rocks, while here and there little drops of spray hung glistening in various cracks and crannies. A pair of glass salmon were leaping the fall. By looking closer I could discern that several fine wires held them suspended in mid-air, but so accurately were they formed by the fingers of genius it was hard to believe that the wand of some modern Merlin had not fixed them thus when in full enjoyment of vibrant life.

Henshaw removed his pork pie and said, "I take off my hat to this!"

"It was indeed a great triumph for Torquilea," Melsona told us. "No less than twenty-seven thousand persons drew lots to decide who should have this particular masterpiece."

He looked wistfully at Henshaw. "Torquilea is crazy about old coins. Only the other day I saw one of his works that will soon be given to somebody. It was simply a small bowl containing a sea-shore pool in glass. Sand and pebbles lay over its bottom; a pair of semitransparent shrimps sported in its depths; a strand of green seaweed grew from a small rock on which bloomed a beautiful sea anemone with all its tentacles fully extended. It was

a reproduction of nature so truthful, so marvelous, one half expected ripples on the surface of the glass. Torquilea is the happiest of men to have his work so eagerly sought after. I am sure he would consider an exchange."

Henshaw took the hint. Fishing out a coin, he handed it to Melsona, telling him to put it to the best use on behalf of us all. This grouping together of we three seemed to please Melsona immensely. He accepted the gift with glee, announcing that he would interview Torquilea at the first opportunity.

Darkness had fallen several hours when we returned to Melsona's house for rest and sleep. We had ridden half the roads of Leamore, explored many shops and buildings, seen many marvels and had been introduced to so many people we could not remember more than a couple of them. Melsona, continuing in his voluntary capacity of city guide, had conducted us hither and thither, declaring himself to be the luckiest of men because our arrival had provided him with the means to use up leisure hours. His conversation, under the continual urge of our questions, informed us of a number of remarkable facts.

We found, first of all, that the day was much longer than in my time, and that Earth's axial rotation was slowing down at such a rate scientists estimated it would have ceased altogether in another twenty to thirty thousand years. The phenomenon dated from the arrival of The Invader, which time inaugurated the new calendar and made this the year 772 N.R.; the letters N.R. standing for "new reckoning."

The Invader, we were informed, was a planet about twice the size of Jupiter, which had come through interstellar space, cleaved a path through the solar system and vanished into the cosmos. It passed between the orbits of Mars and the asteroid belt, its influence upsetting the normal balance of half the system, making the paths of the asteroids, Mars and Earth much more eccentric, capturing and taking with it two members of the Trojans group of asteroids.

We were told that Venus had been reached by rocket ships about fifty years after The Invader had passed, that interplanetary travel was still so difficult, so risky, that the present population of Venus was not more than twelve thousand, and that for every individual who had reached the planet safely another had been killed in the attempt.

Earth's population had not altered in number for the last ten thousand years; all Earth acknowledged a central government situated in Osmia, and the social system was Pallarism. We found that Osmia was on the site of the city I had known as Constantinople, and that the "ism" favored at the moment was based on the theories of a philosopher named Palla, who had lived about 22,800 O.R.

Our stomachs warmed with a late supper, our minds filled with memories of the day's explorations, we went to bed. With quiet deference to my taste, our host had laid upon my bed what looked like a black bathing costume. The crimson nightgown had been transferred to Henshaw's bed. Henshaw came into my room to get my opinion of how he looked prepared for slumber. I fell asleep murmuring a description he could not hear.

XI.

THE following four days I count the most pleasant I have experienced. We traveled extensively with our host, becoming completely at home in this strange, new world. Upon the morning of the fifth day we were riding on the center track of the Derby Highway, toward the outskirts of the city, when Melsona whistled to an old man walking along the pavement in the opposite direction. The old man stopped, Melsona

transferred to the slow track, then to the pavement. We followed.

"This is Senior Glen Moncho," he introduced us. "Senior is a title we have for very learned men," he added in explanation.

"Like professor," I suggested.

"Exactly. This is Senior Glyn Weston and Captain Henshaw." He smiled as we shook hands in turn. "The senior is our most prominent historian. I thought he would have a special interest in meeting you."

Henshaw was quick to seize the opportunity. He asked, "Who won the White-Yellow War of 2481 to 2486?"

"The women," replied the senior promptly.

"The women!" Henshaw looked dazed.

"The war lasted nine years, not five," the senior continued. "It was brought to an end by a militant organization of women who, first of all, refused to bear any more children, then deserted the munitions factories, causing both sides to withdraw great numbers of men to replace them, and, finally, took up arms and assassinated the individuals whom they considered to be the key men of the war. The conflict was the direct cause of the world matriarchy that held sway for the next three thousand years."

"Well I'm a dirty soldier!" cried Henshaw.

"So you're the famous time traveler," said the senior, turning to me. "I've heard a lot about you over the newscast. I understand that you are to be invited to the Annual Convention of Scientists to be held in Metro a week hence. It would be very interesting if you could bring your travel apparatus with you."

"Now isn't that curious!" I said. "I've been here several days and it has never occurred to me to inquire what has happened to the device."

"It is quite safe," said Melsona. "It was carried along on the road while you were being taken into my house. It was rescued and placed in the Science Museum until such time as you wish to have it."

"Good," I responded. "Would you like to go and see it?" Both Senior Moncho and Melsona indicated their eagerness to inspect the time-travel room. We cut through a side street to the next road, moving inward, stood upon an outer five-mile track and glided cityward.

"The most curious thing about time travel," I said to the senior, "is how it alters one's ideas. For instance, one would think that I have defeated Nature by living for thousands of years but, as a time traveler, I know that I have not. Actually, I am about a week older than when first I started my experiment. I now know that Nature has fixed the date of my end, not in terms of years of human computation but in terms of years of my life. I shall die a certain number of *my own years* after my birth, regardless of how that number of years may be divided out, or distributed over the future."

"There is one point which, to my mind, is even more curious," the senior remarked. "How is it that we, with our great civilization, our enormous interest in every branch of science, have not been able to solve the problem which already has been solved by two who antedate us by thousands of years."

"Henshaw hasn't solved it," I told him.

"I was not referring to Henshaw, but to your predecessor."

"My predecessor?" I failed to grasp his meaning.

"I told you that time traveling was known to us," put in Melsona. "I told you when first we met that it had been accomplished before."

I SEARCHED my memory and found that I did have a vague recollection of him mentioning something of the

sort. It had escaped me at the time, as I had felt rather confused.

"When Schweil turned up, claiming that——"

"Schweil!" I shouted at the top of my voice. "Did you say *Schweil?*"

"Yes!" answered the senior, looking very startled. "When he turned up claiming he had come originally from about your time, he was laughed at, and was——"

"Tell me," I interrupted, "from what year did he claim to come?"

"Let me see." He studied the ground and thought for an exasperatingly long time. "It was nineteen hundred and forty-four, I think."

"That's it!" I howled, literally shaking with excitement. "That's it!" Surrounding people stared at me as if they thought I was mad. I was making an exhibition of myself and didn't care.

"Did you know him?" asked the senior, a soothing note in his voice.

"No. He died a few years before I was born. Or he was believed to have died. He set out in his private airplane with the avowed intention of attending a scientific congress in New York. He vanished. The wreckage of his plane reached the shores of Nova Scotia a month later. He was rather eccentric, not very popular, and some people suggested that it was a plain case of suicide. His theories, and those of his successor, were used by me. What happened to him? Where is he? Please tell me about him—everything you know."

The senior looked overwhelmed, took a deep breath and said, "In 312 N.R., four hundred and sixty years ago, this man Schweil appeared on the outskirts of Metro, our great city on the Thames, and claimed that he had traveled through time from the past. His machine took the form of a dull metal sphere about three meters in diameter. Despite his atavistic characteristics, he was not believed. His machine was examined and pronounced a hoax.

"He was in the unfortunate position of not being able to prove his assertations, except by giving a practical demonstration and thus removing himself from the very people who were to be convinced, for he told us that though one could travel into the future there could be *no* motion into the past."

"Quite correct," I said, hanging on every word.

"He was very bitter. According to him ours was the eighth era he had visited and in not a single one of them had he been believed. In the end, he emigrated to Venus, taking his metal sphere with him. He lived there for nearly a year, then managed to convince us that his claims were justified. He did it by stepping into his sphere and vanishing before the eyes of a thousand colonists. He has not returned. We have seen nothing of him since."

"He has traveled forward," I said, jumping about like a cat on hot bricks. "He has traveled forward. Oh, if only I could meet him! A man from my own time, a fit companion for my travels! I *must* meet him! I must find him somehow! He awaits me somewhere in the to-morrow. I must seek him! My travel room must be transported to Venus at once!" So saying, in my crazy excitement I jumped on to the faster center track and rushed along it, my mind filled with only one thought: to get to the Science Museum as soon as possible and arrange for the transport of the room.

The exertion of running must have calmed my mind. Half a mile along the road I transferred myself to the pavement and waited for the others to catch up with me. They came stringing along breathlessly, first Henshaw, then Melsona, the senior a bad last and finding the going hard.

Together we entered the Museum, where Melsona inquired where my room had been placed. Following his lead, we reached it on the top floor. By

this time I had cooled enough to remember that my companions wanted to examine it. I opened the door and proceeded to explain to them how the ray apparatus worked and the theories it made use of.

The room seemed to have suffered slight damage. The outside corners were badly scratched and dented; one of the windows was cracked. I pulled out the valves and ray tube, held them up to the light and examined them, replacing them when I found them still in excellent condition.

I went over the whole apparatus, adjusting a cable here and tightening a terminal there. For several minutes I pottered about like a mother attending to her babe. I was in the act of bending down to examine a McAndrew vibrator contact when a nausea overcame me and the contact blurred before my gaze.

XII.

I STRAIGHTENED, saw the windows framing a semitransparency in which a vague shadow danced, flickered, then disappeared like the flame of a snuffed candle. Panic overcame me, as a familiar mist obscured my sight. I realized what had happened. By some means the projector had come into operation.

Frantically, I searched the enveloping haze for the switch. The rapidly alternating impressions of smoothness and fibrousness fuddled my mind. I searched like a drunken man looking for he knew not what. Everything my hand touched I pulled. I tugged at unseen objects that refused to move. I heaved upon things that came out and sprang back again.

For how long I acted thus I do not know. I grew frantic at the knowledge that my last sweet world was receding rapidly into the irreclaimable past. I commenced to kick wildly in every direction. A crash of glass, followed by a sensation of strain, rewarded my efforts. The mist cleared, leaving me gazing at a broken valve. The time-travel room had come to rest.

A heavy vapor coated the inside surfaces of the windows. My attention was attracted by a loud, hissing sound. I was astounded to discover air rushing outward through the gap in the partly open door. I closed the door tightly, turned the pet cock of the spare oxygen bottle, rubbed moisture from the windowpanes and looked out.

The scene before my eyes was most depressing: a smooth, even expanse of dirt and dust extended to the horizon without break. The sky to one side was sparkled with white light, to the other it loomed a dark, ominous purple. One glance told me that the world of this day was airless, deserted, dead. Horror took command of me with the knowledge that my hours were numbered. Death awaited me without—and within!

Hours later, with the precious oxygen still dribbling away, I stared gloomily through the windows of my room, noting that the sky had not changed in the sightest degree and that apparently I was stationed in a zone of perpetual twilight. Even as I watched, some instinct drew my attention to the far horizon. There, in a majestic curve, swooped a colossal space ship, its sleek body glistening, its tail plumed with fire. My heart leaped as I followed its line of flight until it dipped to an invisible landing place just over the edge of the Earth.

It did not occur to me to wonder why a space ship should fly over an airless world. The idea that I might be the victim of my own delusion never entered my head. I folded a handkerchief to form a pad, secured it over the end of the nearly empty oxygen bottle and opened the door. Ramming the pad

against my nostrils, I ran toward the horizon——

For endless miles I seemed to run with heaving chest, thudding heart and whirling brain. My tongue swelled in my mouth my eyes protruded painfully; I ceased to see. Whether I was moving in a straight line or in circles, I did not know or care. The main thing was to keep moving. Delirium became my master; I moved, moved, moved like an automaton.

I must have dropped the oxygen bottle; I must have fallen and died. But I have no recollection of it. My last memory of Earth is that of fleeing on leaden feet like one chased by phantoms in a nightmare. You know the rest of my story. I came to my senses lying in the resuscitation room at Kar Institute, my body racked with pain, my pulses throbbing in sympathy with the beating of a mechanical heart suspended over my chest.

WHAT NEXT? You are entitled to know. It is my intention to spend a little while touring your beautiful world. I wish to see the sights, to study your customs. With much interest I have learned that the immense amount of work resulting from the Great Migration has caused many radical changes from the world I visited last. I want to read about the Great Migration, to learn all there is to learn about this remarkable epic in human history, to know the nature of the changes it has brought about such as, for instance, your return to a monetary system.

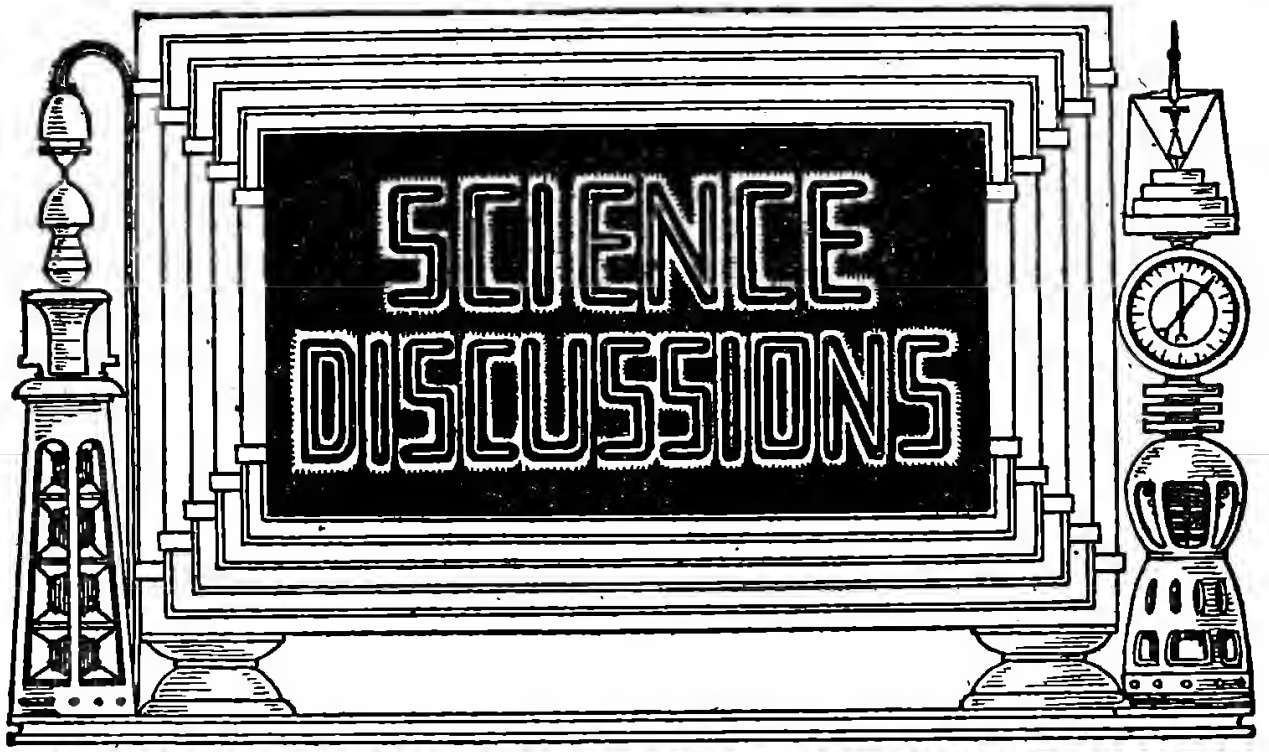
Then I shall set to work and build myself another time-travel room. I shall do this because I am going to find my age-compatriot Schweil. We need each other. Would you like to know how I expect to accomplish this? Let me tell you.

I shall make a series of very short jumps into the future and from them I shall derive the data necessary for certain calculations which, when completed, will enable me to set out for a predetermined date. If Schweil has not turned up by then, I shall leave a message for him, making an appointment far in the future, and will then depart for that date. When Schweil arrives, and gets my message, he will travel to the same date. Thus we shall meet at a rendezvous in futurity.

I have no doubt that the scheme will work, if only Schweil is given my message. You will have to look for him. I am sure that already he has returned a dozen times since last he was heard of. Because of his previous receptions, knowing his character as I do, I can tell you he is likely to return secretly, without publicity.

You can assist me! All I ask of you is that you keep my story and my message ever fresh!

THE STEREO ANNOUNCER padded softly in the direction of the transmission screen. The auditorium was a mass of eyes fixed intently on one central figure. With an abrupt movement, Glyn Weston, the "Seeker of Tomorrow," left the stage.



AN OPEN FORUM OF CONTROVERSIAL OPINION

In Explanation——

Dear Mr. Tremaine:

In connection with the low-temperature work mentioned in the enclosed letter on Pluto, it may be of some interest to understand the present technique of producing the extreme low temperatures available in laboratories, and some of the remarkable effects occurring under those circumstances.

The process of producing liquid air is reasonably familiar, and liquid air is itself the first step in a long series of operations required. In a complete cold-laboratory equipment the following steps are usually used: either a liquid-ammonia plant, or an air-liquefaction plant. This, in turn, is used as the cooling medium for a hydrogen liquefier. The liquid hydrogen is used to cool and liquefy helium. The real work does not begin until the liquid helium is available, for the boiling point of liquid helium is now regarded as a quite high temperature.

The problems involved in this work are interesting. Metals tend to become brittle at low temperatures. What, then, should tanks containing helium under two hundred pounds of pressure at a temperature of 260° below zero centigrade be made of? And what could you use to lubricate the compressor cylinders of an air liquefier? (Even if oil weren't a solid at that temperature, it forms an explosive mixture with liquid air.) Alloys have been developed, and tricks take care of the rest. The air liquefier is, incidentally, lubricated with liquid air, which happens to have lubricating properties. The expansion engine used in liquefying helium can't be lubricated; helium is not a lubricant, and nothing lubricates at that temperature. Therefore, they do without it by mounting the piston on a long, nonheat-conducting piston rod, and lubricate the remote bearings. There are plenty of other problems of purely mechanical nature, however.

Finally, we do have our liquid helium, to produce which we have used about a hundred thousand dollars' worth of apparatus. The temperature of even this is more than 4° A (absolute), or four degrees from the absolute zero we want to attain. From this point on, however, the centigrade scale is almost entirely dropped from the reckoning.

The next step throws over all conventional cooling methods; it has to, because no substance exists which will extract heat at this temperature. The method employed instead is one of the most fascinating operations of modern physics; the heat is pumped out by magnetic force.

Not only iron, and such elements as cobalt and nickel, are magnetic; every element reacts more or less, positively or negatively, to magnetic lines of force. There are three types of reaction: the tremendous, almost violent attraction of iron, nickel, and cobalt—the so-called ferromagnetic bodies—and certain ores also exhibit this property; paramagnetic elements are very weakly attracted by magnets; diamagnetic elements are repelled. These last two forms of reaction are generally extremely weak, so that even the most powerful magnets will not actually pick up a mass of paramagnetic material.

However, paramagnetic elements arrange their atoms in a magnetic field into definite, oriented positions. This is the important property. A paramagnetic salt, such as gadolinium sulphate, may be placed in a magnetic field, whereupon all the gadolinium atoms arrange themselves in ordered, regular files and rows. The basic fact of importance is that in a magnetic field, gadolinium atoms are not moving at random.

Now suppose that a piece of gadolinium sulphate is cooled in liquid helium, boiling under extremely low pressure, to a temperature of 4° absolute. A powerful, magnetic field is applied to the apparatus, and the atoms immediately arrange themselves, losing their bent of random motion to boil further liquid helium. Suppose that the gadolinium is "diluted," by being used not merely as a sulphate, but as the compound hydrated gadolinium naphthalene sulphonate. Before the gadolinium atoms can be arranged neatly and self-satisfyingly they must calm out (by absorbing) the motion of all the hydrogen, oxygen, sulphur, and carbon atoms of that big

molecule. Finally, an equilibrium is reached, and the last of the helium boils off the now-cooled, magnetized gadolinium compound.

Then—the magnetic field is withdrawn. Immediately, the gadolinium atoms fall away into random motion, as rapidly as possible. But—there is darned little random heat motion in that stuff already cooled to 4° A. They attempt to pick up energy of motion, try hard to find it, but there just isn't much to be had. The result is a further, terrific drop in temperature, down, down to the lowest levels reached. Practically the last, faint dregs of energy are absorbed by atoms trying to fall away from their rigidly held, magnetized positions, but unable to get energy sufficient to escape. The very magnetic field that once forced them into place has, in effect, been frozen into them. The temperature drops to 0.004° A.

Normally, when an electromagnet is cut off from its current supply, the magnetic field drops instantly to zero. But when these ultra-frozen magnetic fields are cut off from the source of current the magnetism cannot escape; only as heat leaks in does it fall off. Almost, the magnetic field acts as a substance boiling at a temperature exceedingly close to absolute zero. At absolute zero, a magnetic field will not collapse. Above that temperature it "boils away" more or less rapidly, and is completely "volatile" at even 4° A.

At those temperatures in the thousandths place on the absolute scale, specific heat approaches zero. Normally, it takes six calories of heat to raise the temperature of liquid hydrogen one degree absolute. At those ultra-low temperatures, almost no heat at all is needed to raise the temperature a comparatively large amount.

That substances become superconductors well above this temperature is widely known; perhaps at the temperature of Pluto's poles, lead power lines thinner than human hairs could carry hundreds of amperes of current without resistance.

The possibilities of atomic research in this range are, to-day, attracting wide attention, although the immense amount of labor and the huge investment required for apparatus makes the work very costly. We have not begun to explore the range below 4° A, and barely touched that temperature. Were Pluto's temperatures available, immensely important data would result. Sincerely—John W. Campbell, Jr., 418 Central Avenue, Orange, New Jersey.

Science-fiction of Math.

Dear Mr. Tremaine:

The idea of the fourth dimension seems to have originated with an Egyptian priest about 3,000 B. C. However, nothing much was done with it until the Victorian period, when they started to work in religion.

In the library the theories are listed under "Fourth Dimension," the math being listed under "Hyperspace."

Now my conclusion is that the matter is entirely imaginary. It is fiction, pure and simple. It is being gradually worked up with all frills. They have some real math, I must say. Terminology has been invented to confer every contingency and they have even worked out a value for the time microbe (as I call it), but one author places time as the first dimension.

Science-fiction isn't in it with the stuff they are working up on the fourth dimension. The way they are laying their groundwork, they will reach the tenth dimension before many years have passed. I found one man who was playing with the fifth. The basis of their argument is that the number of lines it takes to locate a point in hyperspace determines the dimension. If it takes six lines, then it is the sixth dimension.

There is such a vast amount of literature on the subject and they have worked the math to such a stage that the study of the fourth dimension, as they have it, will always be in favor with our students of higher math. It offers problems that cannot be beat. In fact, it is the science-fiction of math.—T. A. Hunter, 518 Shepherd Street, N. W., Washington, D. C.

Re: Escape Velocity.

Dear Editor:

It was not the purpose of my recent letter to Science Discussions to create any confusion about the so-called "escape velocity." But several people have seen fit to contest my views on this, and also to question the mathematics involved. So, if space permits, I should like to straighten this out.

Perhaps, for the sake of clarity, the term "escape velocity" should be subdivided into two other terms: "velocity of surface escape" and tangential or "orbital escape velocity." Both have very definite meanings and should be treated as such. The first type mentioned is the one that I had reference to, and merely represents the state of affairs where the rocket or projectile has attained sufficient circular velocity about the earth so that the centripetal force just balances the attraction of gravity.

Now, if the velocity is increased from this point, the result is an expansion of the orbit, and if the increase is sufficient, then the point is reached that is covered by my second definition of "escape velocity." Here, the body breaks away from the earth altogether and would travel to an infinite distance.

These facts are all easily derived from the following formula, which is applicable to any orbit, no matter how elliptical or distorted it might be:

$$V=\sqrt{GM(2/r-1/a)}$$

Where "a" is the "major axis" or greatest radius of the orbit, "r" is any radius vector from the focus (earth) to the ellipse, and "V" is the velocity at the point on the orbit reached by "r." "G" is the universal gravity constant and "M" is the mass of the earth. It can be seen that the variation of "r" can describe orbits even as "open" as those followed by comets.

If the condition is considered where "a=r," as was assumed in my last letter, then the value 4.90 miles per second is again derived. Furthermore, upon reducing the cumbersome "GM" constant to unity and boosting "a" to infinity, we discover that $4.90\sqrt{2}$ is the required velocity to leave the system altogether. It might also be stated that the angle of projection does not affect the final result in the latter case. Also, boosting both "r" and "a" to infinity gives a velocity at that point of zero—which is obvious because there the kinetic energy has all been converted into potential energy, which is equivalent to zero velocity there.

Since the value $4.90\sqrt{2}$ is equivalent to the "escape velocity" of 6.93 m.p.s. recently sent in by Mr. Boelke, it would seem that the two velocities are now very nicely coördinated.

To my mind, the thing about which we should debate is not so much the proven facts of astrophysics, but rather in the correctness of such physical constants as the gravity constant and the mass of the earth. Knowing more about these two things would add more decimal places to our calculations.—William R. Baker, 953 Arlington Avenue, Berkeley, California.

Subject for an Article?

Dear Mr. Tremaine:

Here is some additional information on the great Siberian Meteorite of 1908.

In the "Scientific American" for May, 1931, there is an article by J. G. Crowther, who got information, pictures, and a diagram from Professor Kulik, who visited the meteor site in Siberia.

There were a group of craters 30 to 150 feet

in diameter. Surrounding these craters the trees, over an area 15 to 20 kilometers wide, were still standing, but the foliage had been stripped or slnged from them. Around this area, within a circle 30 to 40 kilometers in diameter, the trees had been knocked down and lay with their tops pointing away from the craters. Beyond this, part of the trees were felled and occasional down trees were found as far as 60 kilometers from the craters.

Kulik found no meteorites and had three theories as to what had become of them: They were either sunk into the ground, had ricocheted back into space, or had vaporized. We thought the meteorites might have come from the north and, if so, might have been the comet Pons-Winnecke.

The sound of the fall was heard as three or four dull thuds as far as 2,000 miles away. Earth shocks were recorded at Jena and strange air waves were recorded at a number of places in England. These air waves were discussed by scientists at the time, but their real cause was not suspected until 1930—22 years later. These air waves had traveled a distance of 3,550 miles in over 5 hours. Unusual sunset effects and lights in the northern sky were noticed for the next two nights in Britain, Germany, and Austria. Professor Kulik estimated the weight of the meteor at 130 tons.

If a 130-ton meteorite could cause all this commotion, what would happen when one weighing one million tons fell? Winninger, in his book "Our Stone Pelted Planet" (1933), mentions one of that weight. It is the great Chinguetti iron discovered by a French expedition at Chinguetti, Mauretania, French West Africa in 1921. It is 325 feet long and 146 feet high. Its weight is estimated at one million tons. There must have been quite a thump when it came down. One can't help but wonder how much this one would shrink in weighing, as Willy Ley says meteorites, like fish, have a habit of doing.

One objection is that such a huge meteorite would sink so deep in the earth that it would never be found. But it might be supposed that it fell thousands of years ago and that the rocks in which it buried itself have eroded, leaving it exposed.

The prehistoric meteor fall which created the Carolina Bays must have been one of the greatest known. This has been carefully studied and it has been estimated that all life east of the Mississippi River may have been destroyed by it. The chance of a major catastrophe being caused by meteorites, at any given time or even in any one man's lifetime is so small as to be negligible, but such a catastrophe is not at all impossible.

I hadn't intended to write as much as this, but I would like to add a suggestion. I believe Joly's theory of geological revolutions would be a good subject for an article. This theory is not generally accepted, but I believe it is treated with respect by scientists. It could be written up from the angle that the moon is periodically the preserver of the world.—D. R. Cummins, 221 J Street, Sacramento, California.

Concerning Iodine.

Dear Sir:

I was surprised to learn that the dispute concerning the physical properties of iodine is still waxing strong. Surely the obvious method of deciding is the same as that used for settling all scientific controversies—experiment.

Any one who takes the trouble of *carefully* heating a few crystals of iodine in a test tube will find, beyond all question of doubt, that the iodine melts, and can be poured from the tube.

In 1898 the melting point of iodine was determined by Lean and Whatmough to be 113.5° C, and two years later, Drugmann and Ramsey found the boiling point, at normal atmospheric pressure, to be 184.4° C.

Let us turn now to the supposed conditions on Venus. The iodine exists, according to Mr. Campbell, at a temperature of 200° C, and under a large pressure. Since the melting point is 113.5° C, and is only very slightly affected by changes in pressure, the iodine can obviously not be in a solid state. Again, as the vapor pressure of iodine at 200° C is about 100 cm. of mercury, any pressure exceeding this—as the "high pressure" would—would be sufficient to produce condensation.

Consequently, the only state in which the iodine could exist is the liquid state, as Mr. Campbell originally stated.—Douglas W. F. Mayer, 20 Hollin Park Road, Roundhay, Leeds 8, England.

How About Relation to Source?

Dear Editor:

In answer to a question by Robert Jones, which you labeled "A Question of Momentum and Light": If an incandescent object in space moves toward you at a greater speed than that of light, it can readily be seen that it would not throw any light ahead of it. If the object is moving, for instance, at the rate of 200,000 miles per second and light is thrown off moving at the rate of 186,000 miles per second, it would not be started before the object had already passed it. Consequently, the object would be moving backward—which is one of Einstein's statements in his theory—namely, that any object moving at a speed greater than 186,000 miles per second (the *approximate* speed of light) would be moving backward.

Also, if you study carefully Einstein's Theory of Relativity, you will find a part in it where he has mathematically proven that there can be no speed greater than that of light, and that no matter how fast an object is moving, light thrown off by it will not add to itself the velocity of the object, but cannot possibly move faster than 186,000 miles per second.

It used to be considered, by most people, that as Einstein's theory was so unreasonable it couldn't possibly be true, and that he was either a clever bluffer or had simply made some serious errors in his calculations. But now his figures have been checked and rechecked so many times, by some of the world's greatest mathematicians, that the possibility of an error great enough to appreciably change the result seems to be eliminated.

I hope this answers Mr. Robert Jones' dilemma satisfactorily.—Russell Stewart, R. F. D. 2, Lebanon, Oregon.

More About Rockets.

Dear Mr. Tremaine:

The debates on whether Atlantis is, or isn't, is one of the most interesting of all your arguments so far. Since I have but a small knowledge of Atlantis, drawn from both sides of the question over a period of years, I won't try to enter my beliefs. But I do have some things to say upon a subject that I do know about.

Mr. Yerke, whatever prompted you to put forth such a ridiculous theory concerning rocket-reaction forces? A rocket is the simplest-known type of engine, simply because of its lack of moving parts. The rocket has been known as a possible weapon for quite a long while, Marco Polo having seen fireworks, in his voyages in the Far East, in which rockets played a great part. The idea was brought back and put to use in the wars in and about the Mediterranean and Europe. But enough of this.

You said in your letter, that the title presented by the editor, "Rockets Need No Resistance," was correct. Of course it is. But you turned about and said later that the impact of the exploding gases against the forward wall of the firing chamber propelled the rocket. If that isn't using resistance for propelling purposes, I'll eat the paper this is written on. That

theory is about as ridiculous as some one saying they have a small sailing boat and they can stand at the stern and blow upon the sail and move the boat. Of course, it may souad a little reasoaable, but you try it. It couldn't even be done with a giant electric fan.

Furthermore, you said that since there is nothing for the emerging gases to react against, in space, when they emerge from the firing chamber, n total loss of eaergy results. This action is the very propelling force of a rocket. It has been proved, scientifically, that an object in free spacc has a tendeacy to move in the opposite direction from anything material-propelled from its parent member. This pertains to the propelling force of explodiag gases ia a rocket chamber, which, emerging from the only exit, the nozzle, tend to propel the rocket body in the opposite directioa takea by the gases. If you've ever held a fire hose, or water hose, under high pressure, you will understand this. This and not your mistaken theory of the impact of gases upon the forward wall sums up the entire reactioaary forces which propel the rocket upon its journey.

As for all the experimental flights being, so far, quite successful, I disagree very much. There have been lives lost and others iujured by exploding rockets before precautionary methods were used upon each flight. It's a very dangerous hobby, if not followed in the proper mannner. I have been interested in rocket propulsion for some time. Earlier in my experimeuts I nearly blew my head off ia an accident is which I, fortunately, was the only oae even injured. Luckily, I wasn't hurt but only shocked.

I am terribly handicapped by the fact that I have to use powder as a propulsion agent, but this is satisfactory to a certain extent, as I haven't the means to use other fuels. Lately I havea't had the time or the place to continue experimentiug, but hope to some day, soon.

The experiments in Germany and lately here in Amerlea, by Dr. Goddard, have doae more toward forwarding rocketry than anything. The experimeats haven't always gone as expected, hut it is my belief that in the next 25 years we will see such chaages iu rocketry that it will be hard to believe.

I have aaother little thiag to argue about. This is to the fellow who signs himself so vaguely as C. T. C.

You said, "Assuming a man weighing 180 pounds on the earth weighs only 25 pouads on another planet. How far ia the air could this man throw a 25-pound weight on earth?" Do you expect the man to throw himself (so to speak)? There is no comparison in throwing n 25-pouad weight aud jumpling, whea the jumper weighs 25 pounds with the strength of n 180-pouud man. Not that I am arguing as to whether a man could jump or not, but I am quite sure he'd feel very featherlike and could put the best high jumper on earth in totnl shame.

As for a man from a planet 1,000 times the size of earth; on earth he could jump 100 feet in the air aad would also live to be an old maa, barring accidents. Any one with the ability to live on a planet of such enormous size, said planet having, of coursc, an enormous gravity, would be able to survive any fall as slight (to him) as 100 feet. His frame would be of such streagth that 100 feet would be as 6 feet to an earthman. At earth gravity an object falls 16 feet the first secoad, 32 the *second second*, et cetera. On a planet 1,000 times the size of earth, as I said before, an enormous gravity would be evident. To an inhabitant of this planet, earth would be a cinch. He'd think he was a feather, or the equivaleat.

David Charney asks, "Why is space black?"

Well, to start, the light that we kaow here on earth is the diffused light of the sun and stars. This diffusioa is caused by the air molecules present, which do not permit the light rays to proceed in a straight line to their destination. This results in the blue sky we see on a clear day. If you've ever seen photographs of the upper stratosphere taken from the balloon that made a record ascension here in the United States, you will see that at the horizon there is considerable light, but as the altitude increases so does the light decrease in inteasity. From this you will readily see that the density of our atmosphere cnuses light rays to be diffused more and more aa they approach the surface of the earth. High up there is little diffusion, hence the lack of light to the eye. Therefore, since space is practically free of light, resulting in almost total darkness, the only way to account for it is the fact that there is no air in outer space. The light which the moon has is only the reflected light of the sun, just as a mirror will reflect the beam of a flashlight.

I hope this will aaswer your question sufficiently.—Yours for science.—Calvin Fiae, Fire Department, Kelly Field, Texas.

Food for Thought?

Dear Mr. Tremaine:

There are still a few points about this evolutioa subject that I wish to commeut upon.

You are quite welcome, Mr. Croutch, for what support I was able to give you. Perhaps our names shall go dowa in scientific history together. Yours for being so bold as to make kaown your "life without-air" theory, and mine—because I was the oaly oae brave eaough to take your part against the unbelieving world.

Our main point was that, in the course of countless milleniums, aa imagiaed race of Martians might ao evolve as to live with less and less amouats of air as their atmosphere dwindled away, eveatually becoming n rsce which needs no air at all as a necessity of life. According to the Darwinian theory, life on Earth began ia the form of siagle-celled animals which were independent of air, and gradually changed to produce modern man who does need air. Certainly, if that happened, it is ao more difficult to believe that a race of beings could do the reverse aad again be so constructed as to be able to survive even as their atmosphere vanished.

At this point I will branch off a little from the original topic of debate and include all life to be found in the universe. I have a complaint to register because of the similarity betweca maa and all extra-terrestrial creatures created by your authors. It seems that all of these writers imagine inhabitants of other worlds as beiug quite like humaas in form nnd other matters, such as neediag to breathe to live, et cetera. But you interpose on the grounds that in some recent stories some of these alien creatures were given four arms, scales on their bodies, and limited to one eye. On the surface they are a bit different. But, then, are not bodies, eyes, aad arms in themselves human characteristics?

I always have thought that authors havea't let their imaginations do justice to the supposed intelligent life oa other worlds. Why should life begin or evolve in any form at all like humans, except on our own Earth? That's right; there is no reason why it should. There are so maay ways they might differ. But writers seem oblivious to that fact and proceed to wish on us forms of life which might be mistaken for our twin brother on a dark street.

They all have the same sense; their eyes and ears are so made as to receive exactly the same wave lengths aa we do, whea, after all, we are able to see nnd hear but a very small portion of the entire visible and audible spectrums; they all have arms and legs which are used for the same purposes as our own; they are all dependeat oa the same substances as are humans for life, as they must breathe atmospheres just the same as ours, nad must drink water and eat food composed of the same elements as ours; and their evolution and motion is at the same rate as ours. Now where, in a creature like that, can you discern any alien qualities?

Once our fictional hero alights on another planet he is, after a while, able to carry on a conversation with the inhabitants of this planet, and the inhabitants all display certain traits that are distinctly human; they even think the

same things in the same way. Personally, I doubt that alien beings would even be motivated by the same instincts and purposes of living as we are.

Come, now, Mr. Tremaine. You allow your authors to stray from convention in ways that break down laws of science. Surely, you may allow them to deviate from precedent when there are absolutely no rules and laws to hold them down.

I hope the foregoing will offer food for thought for you and your authors, and possibly your readers.—Roy A. Squires, 1745 Kenneth Road, Glendale, California.

Science of Spectroscopy.

Dear Editor:

The main reason for this letter is to reply to the criticism, by a Mr. Duncan, of a previous letter of mine.

Mr. Duncan takes exception to my statement that "It has been conclusively proven by spectroscopic analysis that the carbon-dioxide content of the Venusian atmosphere is many thousands of times that of Earth's." To begin with, the authority on whom I made this statement is the astronomer royal of England, Dr. H. Spencer Jones.

To judge from Mr. Duncan's letter, he has a totally erroneous idea of the science of spectroscopy. He writes: "Venus shines only by reflected light, ergo, her spectrum would only show the elements that occur in the Sun." Now, while this is true when applied to the Moon and other airless bodies, it most definitely is not so when planets with atmospheres are being considered.

For example, the light that reaches us on Earth is not pure Sunlight, as it would be if we were above the atmospheric blanket, for certain wave lengths are either weakened or entirely missing due to absorption in the Earth's atmosphere. Oxygen absorbs one set of wave lengths, water vapor another, and so on, while hydrogen, nitrogen, and the inert gases argon, helium and neon do not absorb any wave lengths. Hence their presence can never be ascertained. The loss of certain wave lengths in a spectroscopic analysis of the Sun are due to either of two causes:

1. Absorption by the outer layers of the Sun.
2. Absorption by the Earth's atmosphere.

These causes can be distinguished by comparing the light received from the Sun when it is near the zenith and when it is setting. In the latter case the effects produced by absorption are naturally amplified due to the increased thickness of air through which the Sunlight has to pass.

Therefore, in the case of Venus, if the direct Sunlight (from Sun to Earth) is compared with the Venus light (from Sun-Venus-Earth) the difference must be the result of absorption in the outer layers of the Venusian atmosphere.

Spectroscopic analysis of Venus reveals no traces of oxygen or water vapor, and as Doctor Spencer Jones says: "The only positive information that we have derived is a clear indication of the presence of carbon dioxide in the atmosphere." The astronomer royal also gives the following comparisons: "The atmospheric envelope of Earth is equivalent to a layer 5 miles thick at the surface. Of this the carbon dioxide constitutes only a layer of 30 feet. The Venusian carbon-dioxide content is equivalent to a layer 2 miles thick at the Earth's surface."

With regard to Mr. Duncan's second point that "It is impossible, under present conditions, to ascertain what elements occur in the Venusian atmosphere, due to the thick veil of clouds," I can only reply that I am well aware of the fact, and add that the figure quoted above for the amount of carbon dioxide in the Venusian atmosphere is derived from the results of analyses above the cloud layer; and the atmosphere above the cloud layer is only in the region of one mile in thickness. This cloud layer apparently furnishes direct evidence of the existence of water vapor, but failure of the spectroscopic analyses to detect this compound is probably due to all the water vapor having been condensed out of the upper atmosphere. I hope I have made my point clear to Mr. Duncan.—J. H. Plimsoll, 212 Ashby Road, Burton-on-Trent, Staffordshire, England.

What Do You Think?

Dear Editor:

It is rather evident from your February issue that Mr. Pizzano doesn't agree with my views on *Glagula*. His arguments are very simple to answer, though.

First, if a person lived on a radioactive planet, that always possessed an even temperature, he could learn absolutely nothing about temperature changes on other planets, because, though he might see an ice pack form or melt, how could he know what made it? He wouldn't possess the slightest idea of temperature. If he sent balloons into the upper atmosphere, and frost formed on them, it would certainly be gone as soon as the peculiar radioactivity I mentioned hit it. Glagula would never see the frost. As for friction on even a radioactive world, certainly. But heat from friction would be immediately equalized with the surrounding atmosphere. Does that take care of Mr. Pizzano?

Now for Mr. Leonard Kramer, who proposed such an interesting theory on time and the infinity of numbers. I have only one question to ask: "Is it possible to divide a second?" Of course, there are divisions on the face of a clock, but those are divisions of space not of time. Personally, I do not think it possible to divide time. For that matter, I'm not sure there is such a thing as time. But that's another story——

Wishing you luck with Science Discussions.—Hugh McKenna, Jr., P. O. Box 734, Seaside, Oregon.

Against the Fourth Dimension.

Dear Sir:

There are many arguments about the 4th dimension (I do not mean time), but every one seems to agree that there is one. I hereby introduce an argument against it.

If there is a 4th dimension, we must have extension in it. Everything in the universe must extend into the 4th dimension, because it is impossible for an object to exist without all the proper dimensions. There are no 2-dimensional objects. A body ceases to exist if it does not have *all* of these dimensions: time, length, breadth and thickness, and any other dimension which exists in the universe. Therefore, if there is a 4th dimension, everything in the universe must be 4-dimensional.

If so, why do we *think* we're 3-dimensional? If we are 4-dimensional, or higher, why do we see in only 3 dimensions? Our eyes ought to extend into the 4th dimension. If everything else does. We ought to have a 4-dimensional brain. Then why can't we see it or conceive of it?

The only conclusion is that there is no dimension higher than 3.

If time is a dimension, then there are 4, but no more than 4. If this is right, which it might be, what happens to the curved-universe theory?

Mr. Campbell says in his 9th article, in the February issue, that it took only 3 hours to form the solar system. The sun travels 12 miles a second, and if the other star had about the same speed, the total speed in meeting each other would be 24 miles per second, so all the distance they would cover in 3 hours would be 259,200 miles. During the making of the solar system they ought to have traveled 3,000,000,000 miles; that is, they pulled planetary matter that far out of each other as they left, after passing each other, and the creation of the solar system

was still in progress until the other star was so many billions of miles away that its influence was not felt. The whole thing would take many years. It would take one year for the sun to travel only 400,000,000 miles. The difference in time between 3 hours and 10 years is so vast that I wish Mr. Campbell would explain how he came by his conclusion. His articles are very interesting and add to the scientific value of the magazine. How about an argument on that 4th-dimensional question?—Donald Franson, 3022 North Kenneth Avenue, Chicago, Illinois.

Attention, Mr. Bond.

Dear Mr. Tremaine:

Edgar Allan Poe, in his palmiest days, had nothing on Nelson S. Bond's conception in *Down the Dimensions*. And underneath it all there is a chuckling sense of humor in Mr. Bond. Yes, sir, he tells us he is spoofing us and then makes us like it. Which is more than pseudo-science. By Heaven, it's art! Then, too, you put the thing down with a feeling of "that fellow can write," and who among us asks more than that?

Thank him for me.—Elmer Ransom, 2870 Henry Street, Augusta, Georgia.

Contemplation.

Dear Editor:

I seize upon the letter of Albert T. Stone in the March Science Discussions as an illustration of a theory I had put forward in the previous issue.

Provided that the human mind is capable of only a limited number of impressions (or that only a limited number exist), and that each experience is recorded in the mind, it is logical to believe that when one's senses are aware of a group of impressions approximating a previous group, one will feel that the event has taken place before, and under the exact conditions.

I have had the experience many times, always undergoing as a result a short period of confusion. One can gain much from the contemplation of his own mind.—Claire P. Beck, Stonybroke, Lakeport, California.

Likes Serials.

Dear Editor:

May I direct some remarks to your readers?

Mr. Enelow: Serials make possible the long stories that you and I both enjoy. Why not save the story until you have all installments?

Mr. Stone: I have experienced the sensation which you describe in the March Science Discussions many times. I, too, am at a loss to explain it. I am sure I didn't dream the situation before, yet that curious feeling exists. If I believed in reincarnation, I could say that I *had lived* that same moment some time in the past, and that by some odd quirk of circumstance, subconsciously recalled that event. I wonder?

Mr. Brazier: Your letter was very interesting. All I can say is that the English lady lacks imagination enough to understand and enjoy a most delightful form of literature—*science-fiction!*

You have suggested that readers limit the length of their letters. That seems to be a good idea. But letters such as those by Dr. John D. Clark and Mr. James A. White should be printed regardless of their length. They are so interesting.

If Donald Schrader of South Bend, Indiana, reads this, will he please communicate with me?—Donald Campbell, 1533 Alter Road, Detroit, Michigan.

"An Experiment With Time."

Dear Editor:

I was intensely interested in a letter from a Mr. Stone, printed in your March issue, in which he discusses, briefly, a mental phenomenon he and two of his friends have experienced. I do not think that this is at all uncommon, as I myself have experienced it, and have discussed it with a great many people besides myself, who have also experienced it.

Usually, when I encounter a situation and feel that I have lived through it before, I seem to be able to foretell, to myself, just what will be said or done within the next few instants. The occurrences concerned are, invariably, very trivial things, such as the position and words of a visitor, and some inconsequential action of his. A book has been published (I remember neither the author nor the publisher) which contains a very complete theory, explained mathematically, and which also contains a variety of lucid case histories. It is called "An Experiment With Time," and involves the dream idea. I should be very interested in hearing again, in Science Discussions, from Mr. Stone.—William A. Wooding, 268 Piedmont Street, Waterbury, Connecticut.

Repetitions Explained.

Dear Editor:

My attention was drawn to Mr. A. T. Stone's letter in the March issue, on what he calls "sensation of repeated occurrences." I do not know if this peculiar sensation has come to the attention of psychiatrists, psychologists and other students of the behavior of our mental processes, but I am sure it has been noticed by many a puzzled layman.

Being a silent thinker (?) rather than a voluble theorist, I have kept my opinions rather to myself. But since the subject has been broached, I'll accept Mr. Stone's invitation and add what few and meager observations I have made to this most complete epistle.

It seems to me that these "sensations of repeated occurrences" are scientifically explainable or would be if our mental processes were more fully known. In my opinion, there are several purely orthodox scientific explanations, all hinging on the function and misfunction of our brains and nervous systems.

The most obvious interpretation, to me, is anticipation. Sometimes we imagine some common actions with a higher degree of accuracy than we are aware of. Memory and reasoning come to us much more rapidly in regard to familiar happenings. Thus, every one of our actions, forethought, is recorded in our minds before we proceed with our present doings. Not realizing this rapid functioning of our thoughts, we are puzzled and usually think the occurrences have taken place in the past.

Then, we could attribute this phenomenon to a sort of short circuit of the sensory nerves, which could affect several messages of the actual happening to reach our recording apparatus at different times. There are many defects in our nervous system which could account for this.

The most obvious explanation to the commonsense mind is that the action or state has actually occurred or been, and forgotten, suddenly pops up in the vision by sympathetic resonance. However, it takes a very uncommon sense to understand the mysteries of the mind. Thus, any *wild* conjecture such as Binder's and yours, Mr. Stone, may be the true solution to this mystery.

Perhaps no man is a better authority on this subject than a psychiatrist or a psychologist or a neurologist or some other classified scientist. Well, if there are any in the audience, how about a little explanation? We would appreciate it very much, I'm sure.

I hope I've made myself clear.—Camillo J. Massoni, 215 Fifth Street, S. E., Washington, D. C.

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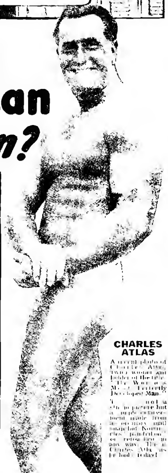

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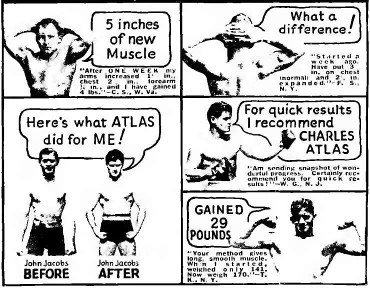

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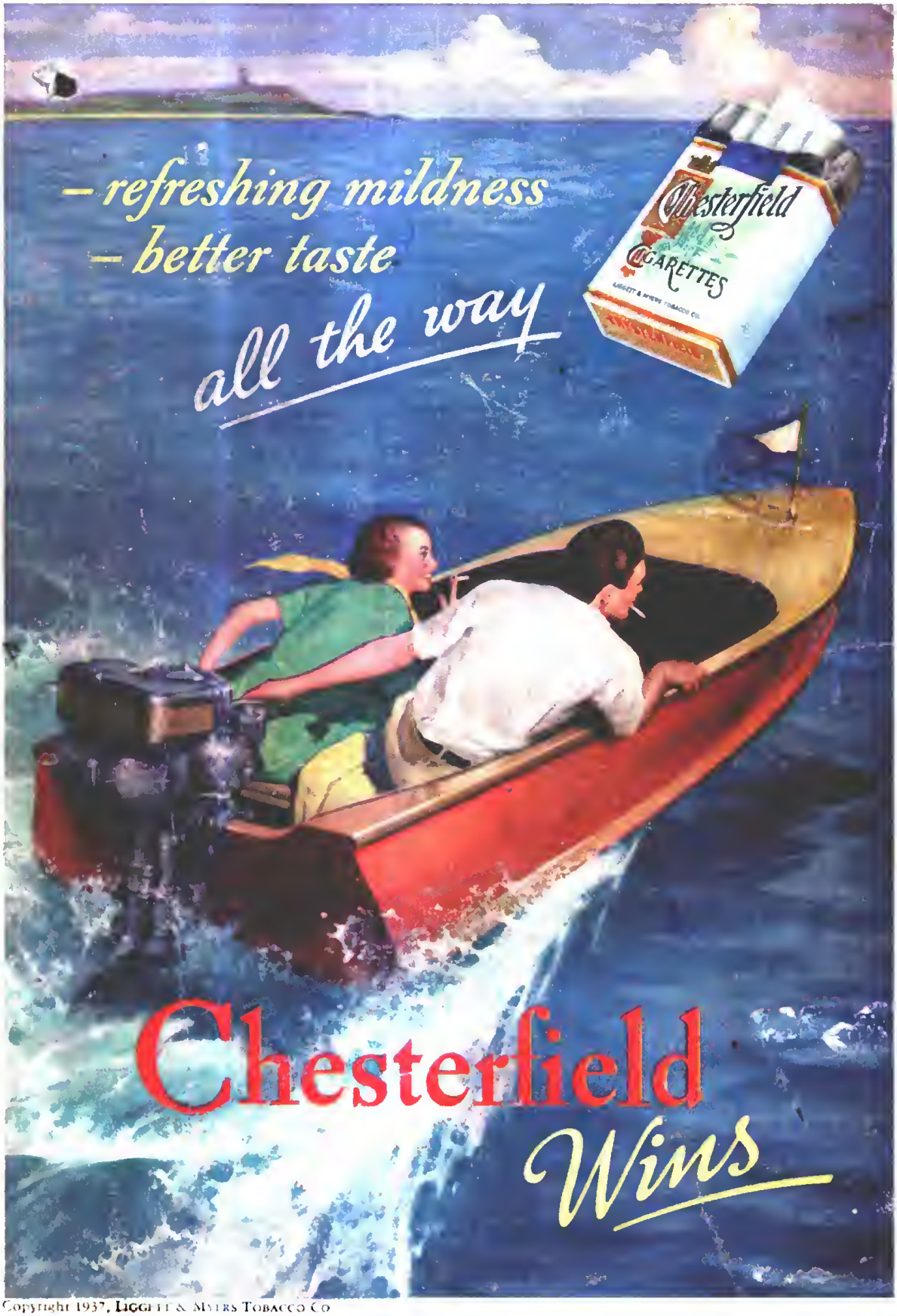

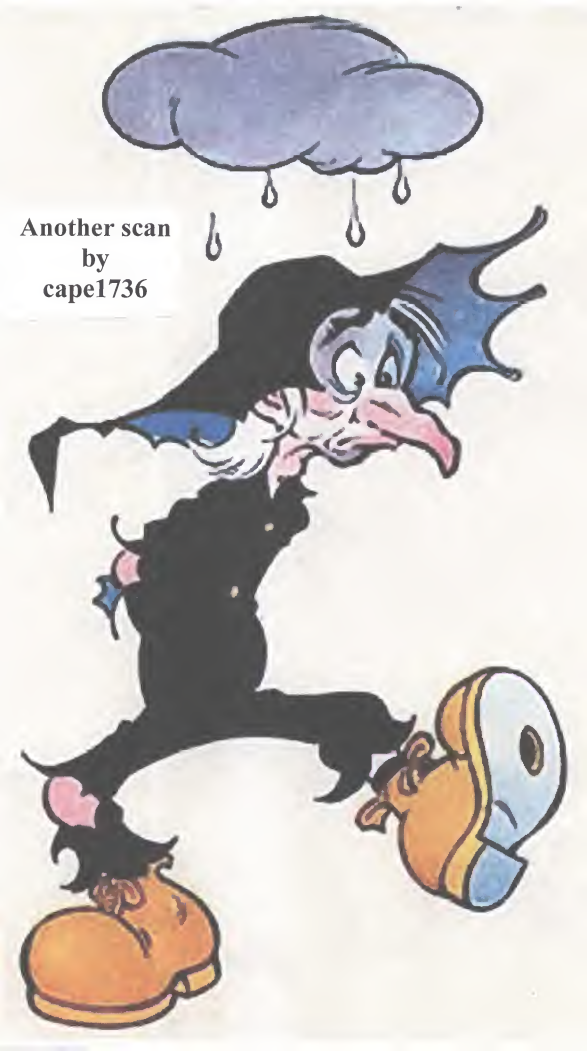
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